

Popular Science

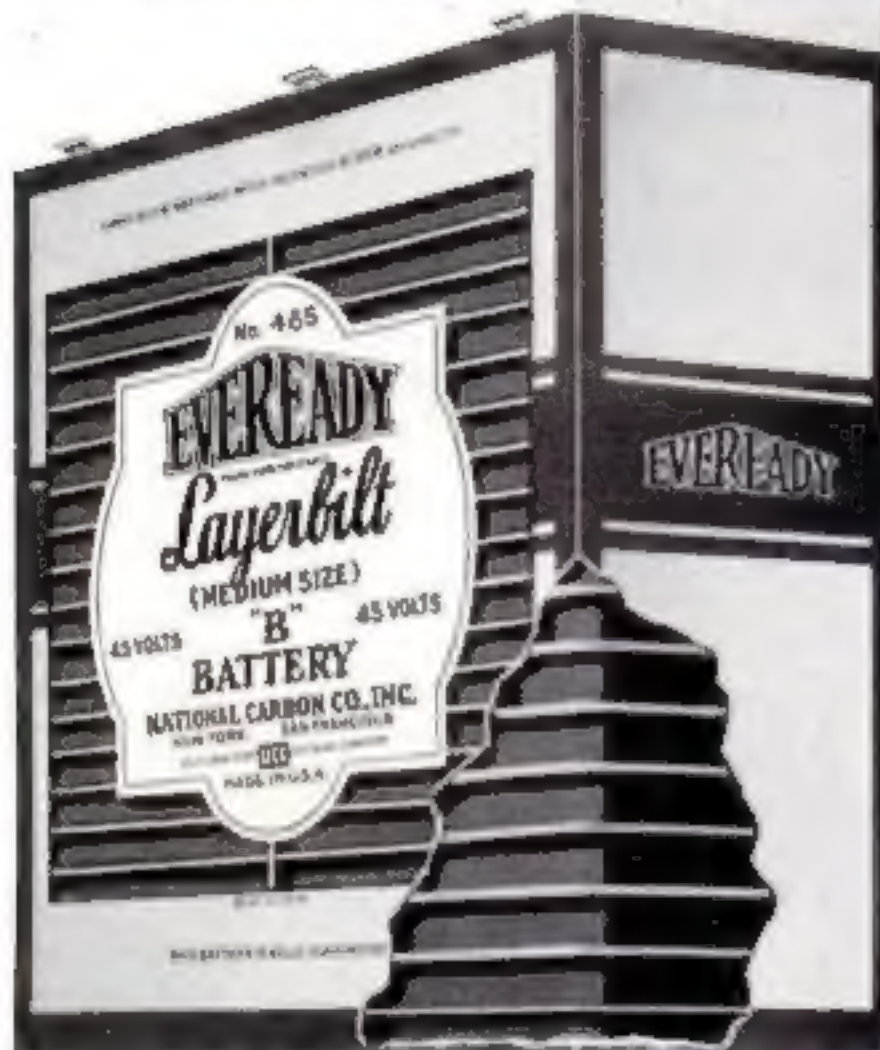
November
1928
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New Ideas: Aviation - Radio - Automobiles - Home Building
Engineering - Exploration and The Home Workshop

for just a few cents more The EVEREADY LAYERBILT



Now \$2.95 Eveready Layerbilt Medium Size "B" Battery No. 485. 45 volts. The longest lasting Eveready of its size.



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lasts weeks and months longer

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Only Eveready makes Layer-
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duty, the longest lasting of all Evereadys and the most economical. It costs 25 cents more than a cylindrical cell Eveready of the same size. The other is the newer Medium Size Eveready Layerbilt No. 485, which has the same dimensions as the Eveready No. 772 (cylindrical cells), but which lasts much longer than that battery, though costing only 20 cents more.

When you go to buy new "B" batteries, add just a few cents to what you would pay for a cylindrical cell Eveready, and get Eveready Layerbilts. They will bring you weeks and even months of extra service.

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For almost a quarter century, this reputation has been building. The business ethics and standards which have made it are still in daily force throughout the Cadillac-La Salle dealer organization—in used car as well as new car selling.

CADILLAC MOTOR CAR COMPANY

Division of General Motors Corporation

DETROIT, MICHIGAN

OSHAWA, CANADA

WHAT IS NEW THIS MONTH

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"I Wish...."

said Joe Miller

"I missed my chance to make a wonderful investment when I passed up an opportunity to buy shares of Financial Investing Co. of New York, Ltd., when that investment trust was starting in January, 1925. I could then have purchased 100 shares for \$1,500; today they would cost me over \$2,800.

"And that's only half of it. In the last 3½ years I would have collected dividends and stock subscription rights amounting to \$510. No wonder Financial Investing stock went up, even last June, when almost everything went down.

"I wish I had bought Financial Investing shares. That investment trust was established on a sound plan and has been conservatively managed by experts. Counting market gain I would have made well over 100% on my money in 3½ years. What a chance I missed!"

"I Will...."

said Jess Phelps

"I've got the same opportunity now that Joe Miller missed in 1925—a chance to buy shares of Second Financial Investing Corporation while it is on the threshold of its growth.

"Since Second Financial Investing Corporation and Financial Investing Co. of New York, Ltd., are both managed by United States Fiscal Corporation, and as both are alike in general plan and purpose, I believe that Second Financial will do what Financial Investing has done.

"I am going to invest in Second Financial now and profit as it grows."

You May Invest in One Share or More

Shares in Second Financial Investing Corporation, first offered early this year at \$25 each, were selling above \$28 in September. The Corporation began paying dividends July 2. You now have the opportunity to become an original stockholder—to invest in one share, or as many as you wish, of Second Financial Investing Corporation and profit by future dividends and increases in market value.

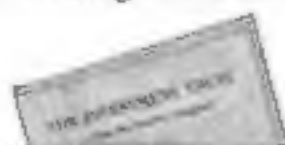
Learn How to Make Big Profits Conservatively

It is all explained in our booklet, "The Investment Trust—from the Investor's Viewpoint," and in literature describing Second Financial Investing Corporation. Mail the coupon and profit by reading this free literature.

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Managers of

Second Financial Investing Corporation
and
Financial Investing Co. of New York, Ltd.



United States Fiscal Corporation
80 Broadway, New York

Please send me, immediately, your free booklet that tells how I can invest for financial independence.

Name

Address

Clipping the Wings of an Increased Salary

By WALLACE AMES, Financial Editor

"**M**ARTHA!" called out Waldo Sims, as he burst in the front door of their bungalow one evening. "How soon can you jump into your best bib and tucker? We've got some important celebrating to do. I've reserved a table at the Monte Cristo Club right on the ring-side just for you and me. If we hurry we will get there in time for the dinner show."

"I'm sorry, but I am afraid you will have to cancel the reservation. This is Thursday, the maid's day off, and it is too late now to get anyone to come in and stay with Judy. What especially is there to celebrate tonight?"

"The luckiest break in the world! You're listening to the manager of the new West Coast sales branch. It is to be opened the first of the year with Yours Truly as the big boss. My salary is jumping from \$125 to \$150 and if I make a good showing the first six months it will be boosted to \$175. And I'm to share in the profits, too. We will be living on \$800 a week less than a year from now.

"As soon as we get out West we will join a country club. We'll sell the old bus right away and get one of those classy sport models and drive out to the Coast in style.

"Gee! I wish we could celebrate tonight. I tried to 'phone you so that you could make arrangements, but the operator said the 'phone was out of commission."

"It is probably a gentle hint," suggested Martha, "that the company would like to have last month's bill paid."

"They're getting fussy again, eh? That old company never lost any money through us. I'll call them up tomorrow and give them the devil."

"Waldo, I'm sick of all this," Martha burst out. "All the household bills drag on unpaid until it is embarrassing. You ought to see the way the butcher looked at me when I was in today. And what do our friends think when they can't get us on the 'phone? They know."

"And that's not the half of it. Year after year we go on paying profits to the landlord. Before you know it little Judy will be ready for college and there will be no money to send her with. Right now you've borrowed up to the hilt on all your insurance."

"When we were married you were making \$800 a week and we lived comfortably on that. Now you are earning more than twice as much and we are not even getting by. Within two weeks of the time you get every raise the money was all spent. Now that you have another advance the first thing you do is to plan to spend it."

"You are a good natured, easy going spendthrift. You have business ability when you are in the office, or you would not have received this promotion. But when it comes to the business of managing your income you are a failure—just a failure." And Martha burst into tears.

"Why, honey, I never heard you talk like that before," said Waldo. "You don't really mean that the new Western sales manager is a failure. You're just excited over our good fortune and it has made you hysterical. Tomorrow you get your sister to go on a shopping tour and begin to outfit yourself for your new station in life. I want you to have a lot of new duds when we go West."

The next evening happy-go-lucky Waldo arrived home in his usual high spirits. "Did you go (Continued on page 6)

How Norman and Hattie Accumulated \$32,000

This schedule of earnings, expenses and accumulations vividly shows how anyone on a normal salary can get ahead without hardship by conserving salary increases. On these figures this month's story is based.

Age	Weekly Salary	Living Expenses	Weekly Savings	Year's Investment Income	Total Worth at End of Each Year
24	\$ 30	\$25	\$ 5	\$ 5.20	\$ 265.20
25	50	35	15	26.20	1,071.40
26	60	35	25	90.26	2,440.25
27	70	40	30	177.61	4,177.86
28	80	40	40	292.27	4,000.00 (1)
29	90	70 (1)	20	260.80	5,300.80
30	100	70	30	349.20	7,210.04
31	100	80	20 (2)	453.40	8,703.44
32	110	85	25	548.20	10,551.64
33	110	85	25	659.09	12,510.73
34	125	85	40	792.24	15,382.97
35	125	85	40	964.57	18,427.54
36	150	90	60	1,168.05	22,715.59
37	150	90	60	1,425.33	27,260.92
38	150	90	60	1,698.05	32,078.97

(1) Increased expenses due to marriage.

(2) Decreased savings due to birth of child.

(3) Decreased worth due to expenses selling up housekeeping.

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Clipping the Wings of an Increased Salary

(Continued from page 4)

down town and get yourself some nice tricky new dresses today?" was his first question.

"No, Waldo. Hattie and I went down town, but I didn't do any shopping. Something made me change my mind."

"What was it, dear?" inquired Waldo. "You know we are partners and I want you to be the first one to profit by my good fortune in business."

"I met Hattie just before lunch. She wanted to go to the bank first. Norman had asked her to put two thousand dollar bonds in their safe deposit box and there were some coupons to clip and cash."

"I wish you could have seen their deposit box. Thirty-two bonds in it!"

"You don't say!" ejaculated Waldo. "Did some rich uncle die, unbeknown to us and leave them all that wealth?"

"Wrong again, Waldo. They bought those bonds with their own money. Some were bought with savings; income from their investments paid for the rest. Hattie told me all about them at lunch and what she told me spoiled my taste for spending money shopping."

"It seems that even before Hattie married Norman he had formed the habit of keeping his expenses below his income and saving the rest. Every time he got a raise in salary he saved most of it instead of blowing it in. So he had \$8,500 when they were married. They spent \$2,500 for furniture and a honeymoon trip and started life together with \$4,000 ahead."

"Right from the beginning they kept their expenses under control. Of course they spend more now than they did ten years ago, but they have not allowed their increased living expenses to eat up every salary raise. When Norman was making \$80 a week they lived on \$70; when his salary was \$125 they spent \$85; now he is making \$150 and they live on \$90."

"This year their income from savings and investments alone amounts to nearly \$1,700. On a salary just a little larger than yours they are now saving away nearly \$5,000 a year, while we are continually getting deeper into the rut."

"That's what spoiled my taste for shopping this afternoon."

"Never mind, Martha. Everything is going to be all right. We'll be sitting on top of a pile of bonds some day. Just you wait and see."

"But don't you see, Waldo," earnestly entreated Martha. "you are going on and on, leaving the future to take care of itself. You say, 'Just wait and see.' I've been waiting ten years now."

"I was a little harsh with you last night. Really I was just as elated over your promotion as you, but my emotions got the best of me for once. Today I feel better because I have a plan by which we can profit by your increased income."

"If Hattie and Norman can live as comfortably as they do on \$90 a week we can do it. When we get out West my plan is to start all over again, with a clean slate. If things go well and your income advances as we both (Continued on page 6)



\$2,500 Interest from \$10 a Month

\$10 invested each month at 6 1/2% with the interest re-invested at the same rate will accumulate \$4,880.10 in 20 years. In these years you will have invested in cash only \$2,400 and your earned interest will be \$2,480.10—more than the sum actually invested in cash. Even at forty, if you invest \$50 to \$100 a month, you will be well-to-do by your sixtieth birthday.

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By systematically reinvesting the interest from your first bond, it will help to pay for another. Soon you will have interest on two bonds helping you pay for a third; interest on three bonds helping pay for a fourth, and so on. Can you think of a faster, surer method for the average man or woman to gain financial independence?

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that brush

Shave the Modern Way.

Makes Your
face feel
Like a
Million Dollars



Soothing and Healing

Apply
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with palm of hand



Speed the shave 8 minutes



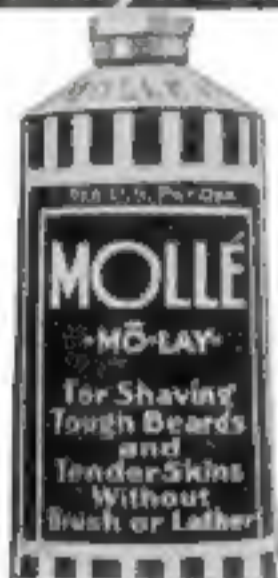
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No Pulling or Cutting



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"A million men can't be wrong" say the college chaps. So give your face a "break" and buy MOLLÉ. Get the giant half-buck tube from your druggist—or send a dime for the seven-day tube that has shown a million men the way to quicker, smoother shaving. Now we're working on the second million—come on along! A whole of a tube for 30c—your druggist has it.

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Enclosed find 10c (cash or stamps) for which please send a week of MOLLÉ Shaves, to:

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City..... State.....



Clipping the Wings of an Increased Salary

(Continued from page 5)

hope it will, let's save all the increase. Let's not think of new ways to spend money until we have a snug safe deposit box full of bonds.

"Once in a while we will go on a little bat, or indulge in some luxury and we'll enjoy it all the more, because we will know that we can afford it. It will be easy to change our habits in a new country and I can hardly wait to start."

"You are a game little kid, Martha, and the best little manager in the world. I am with you 100%," said Waldo.

And that evening was one of the pleasantest they had ever spent together, as they planned out the details of their new financial start.

To Help You Get Ahead

THE Booklets listed below will help every family in laying out a financial plan. They will be sent on request.

"Ideal Investments" is the designation universally accorded Smith First Mortgage 6½% Bonds which carry attractive tax refund features. A history of the House and information relative to their bonds and the safeguards that surround every issue they offer may be obtained by addressing the home office of The F. H. Smith Company, Smith Building, Washington, D. C.

The House Behind the Bonds reminds the investor of the importance, not only of studying the investment, but of checking up the banker who offers it. Address: Fidelity Bond & Mortgage Co., 1138 New York Life Building, Chicago, Ill.

"The Investment Trust from the Investor's Viewpoint," presents an explanation of this form of investment in easily understood terms, illustrated with some interesting examples of how the general investment trust will help the man with \$100 or more to get ahead. Published for free distribution by United States Fiscal Corporation, 30 Broadway, New York. Ask them for Booklet IT.

How to Retire in Fifteen Years is the story of a safe, sure and definite method of establishing an estate and building an independent income which will support you the rest of your life on the basis of your present living budget. Write for the booklet to Cochran & McCluer Company, 46 North Dearborn St., Chicago, Ill.

How to Get the Things You Want tells how you can *own* insurance as an active part of your program for getting ahead financially. Phoenix Mutual Life Insurance Company, 318 Elm Street, Hartford, Conn., will send you this booklet on request.

The Guaranteed Way to Financial Independence tells how a definite monthly savings plan will bring you financial independence. Write for this booklet to Investors Syndicate, 100 North Seventh Street, Minneapolis, Minn.

The Making of a Good Investment tells how 6½% can be made on investment in First Mortgage Bonds in units of \$50, \$100, \$250, \$500 and \$1000; how the bonds are protected and how simple it is to purchase them. For a copy of this booklet address United States Mortgage Bond Company, Limited, Detroit, Michigan.

Retire in 15 years

on your Present living Budget

by investing in safe First Mortgage Bonds

Follow the definite plan given in this book, and your financial independence is won.

The plan works just as surely, whether you are now earning \$1,000 or \$100,000 a year.

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We invite the most skeptical to read this plain, straightforward, interesting book.

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By F. E. SENGSTOCK, E. E.

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It completely covers inside electrical wiring and construction in accordance with the National Electric Code. Pocket size—flexible binding

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POPULAR SCIENCE MONTHLY
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Through authorized dealers everywhere

The Right Way to Save Ice



Some Surprising Facts about Refrigerator Care Are Brought Out by Laboratory Tests

By

Prof. R. D. Morrill

*In charge of refrigeration at New York
University and Popular Science
Institute of Standards*

Prof. Morrill outside the heat-insulated door of the constant temperature room in which refrigerators are tested.



HURRY up and close the icebox door!" is an instruction that echoes through many an American home, and we sometimes wonder if this business of getting the refrigerator door closed quickly is worth all the commotion it causes.

Just what happens, when this injunction is not carried out as promptly as it ought to be, now has been definitely determined. Laboratory tests in which special recording thermometers settle the matter beyond question have been completed by the Popular Science Institute of Standards. The results show the true importance of opening refrigerator doors rarely and closing them promptly—not only for the saving of ice but, more important, for the maintenance of proper temperatures for keeping food safely free from bacteria.

With a good grade ice-cooled refrigerator that had two inches of corkboard insulation, a test was made to determine the rise in temperature inside when the food compartment doors were left open. The room in which the refrigerator was placed while these tests were being conducted was at a temperature of 77.8° F.

The refrigerator was fully iced at 8:03 a. m. and the food compartment doors were not opened until 1:43 p. m., when the refrigerator was down to a temperature of 51° F. The doors were then left open five minutes, and at 1:50 p. m. the average temperature of the box was up to 68.3° F.—a seventeen-degree jump in only a five-minute interval.

The food compartment doors then were closed from 1:50 to 2:35 p. m., the refrigerator temperatures being recorded at five-minute intervals during this period. By 2:35 p. m. it was found that the average temperature of the refrigerator had dropped to 52.4° F.

These results show that it requires a long time for the refrigerator to recover its lowest inside temperature if the food compartment doors are carelessly left open for several minutes. The time required for complete recovery was approximately ten times the interval during

which the food compartment doors were left open.

This means that if a refrigerator is to be kept at a temperature that will safely preserve food, one of the most important requirements is that food be put in and taken out as quickly as possible, and that the doors be opened as few times in a day as possible.

But, while the quick closing of refrigerator doors is a good policy both from the standpoint of proper refrigeration and ice saving, the custom of wrapping the ice, followed in many households, is a very poor practice indeed.

Various so called ice blankets have been—and are still—advocated for wrapping ice to keep it from melting. Even newspapers and cloths have been put over the ice cake to preserve it. This practice prevents free circulation of air about the ice. Not enough ice is exposed to fully refrigerate the food compartments; also the entire surface of the ice cake is needed to absorb the food odors carried by the air.

Tests made on a good grade refrigerator in a room whose temperature was at 76° F. brought out the following results:

WHEN the ice was unwrapped, twenty-six pounds were melted in twenty-four hours. The temperatures in the milk compartment under the ice chamber, the bottom of the main food compartment, the center of main food compartment, and the top of the main food compartment were respectively 41°, 45°, 47°, and 50.5° F.

Keeping the same box in the same room temperature for twenty-four hours with the ice wrapped showed an ice meltage of twenty-three pounds. The refrigerator temperatures in the before-mentioned locations were, respectively, 43°, 46.5°, 49°, and 51.5° F.

These results demonstrate that three pounds of ice a day may be saved by wrapping the ice cake, which means a daily saving of less than two cents. Offsetting this money saving is the increased refrigerator temperature and its consequences. Food odors and bacteria

are retained inside the refrigerator, instead of being caught on the surface film of water on the ice cake and discharged outside the refrigerator through the drain pipe and trap to the sewer. The ice surface must be exposed if full benefit is to be obtained, and if bacteria and food odors are to be absorbed properly.

FOR good refrigeration, it is essential that a well-built and well-insulated box be used, and that it receive proper care. This free List of Approved Refrigerators offers a solution to the buyer's problem of deciding which refrigerators are well constructed, a good value, and capable of maintaining proper temperatures economically with a minimum consumption of ice or power. The names of tested and approved refrigerators of both automatic and ice types can be obtained on request from the Popular Science Institute of Standards. Also, the engineers of the Institute have prepared a twenty-four-page booklet giving full information on the selection and care of refrigerators. There is a twenty-five-cent charge for the latter. Address the Popular Science Institute, 250 Fourth Ave., New York, N. Y.

Popular Science Monthly GUARANTEE

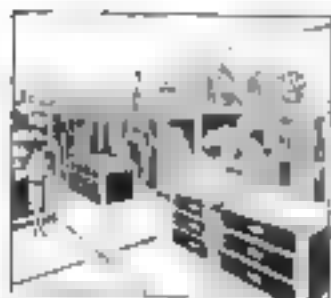
The above seal on an advertisement indicates that the products referred to have been approved after test by the Popular Science Institute of Standards.

POPULAR SCIENCE MONTHLY guarantees every article of merchandise advertised in its columns. Readers who buy products advertised in POPULAR SCIENCE MONTHLY may expect them to give absolute satisfaction under normal and proper use. Our readers in buying these products are guaranteed this satisfaction by POPULAR SCIENCE MONTHLY.

THE PUBLISHERS

This grainless wood board can be cut out, punched, die cut and shaped!

Has a smooth, attractive surface on the face side and requires no paint for protection. Also takes any finish beautifully. Possesses uniform strength, highly resistive to moisture, very dense and tough. New uses discovered almost every week. Send for large free sample, and find out what you can do with Masonite Presdwood.



FOR STORE FIXTURES

If you are a manufacturer, an inventor or a mechanic of any kind, you will certainly want to know all about Masonite Presdwood, the grainless wood board of a thousand uses.

Presdwood has now been on the market over two years, and in scores of industries it has helped

to make good products better and cut down operating costs.

In fact, results prove that Presdwood is workable and adaptable almost beyond belief. It can be cut out. It can be die cut and punched. It will not crack or check. It will not split or splinter. It can be used on saw, planer, sander and shaper. It is highly resistive to moisture, it has uniform strength, it is very dense and tough. It has a smooth, attractive surface on the face side, requires no paint for protection, and takes any finish beautifully.

"A truly wonderful product," says practically everybody who has put it to the test. And note particularly that Presdwood contains no foreign substance of any kind, not even a chemical binder. It is simply wood torn apart and put together again—clean, fresh wood straight from the forest, and nothing else!

Astonishing range of uses

There actually seems to be no limit to the uses for Presdwood. We ourselves are astonished almost every week by some entirely new and unexpected demand for it.

Not only are thousands of feet of it going into the making of such things as table tops, breakfast nooks, store fixtures and signs, but it is being extensively used in the manufacture of toys, doll houses, fire screens, tension boards, bread boxes, clothes hampers, and dairy containers.

Bank vaults and telephone booths are lined with Presdwood. It is being widely used in building steam boats. It makes an ideal flooring for dance halls and park pavilions. It is becoming more and more popular for all kinds of paneling.



FOR PANELING

Cooling trays for hot castings, starch trays for candy factories, bedroom screens, invalid trays, incubators, dust arresters for journal boxes, bowling alleys, and shutters for Dutch Colonial Houses—all of these things are made of Presdwood.

Where especially fine, smooth work is required, there is nothing like Presdwood for concrete forms. Presdwood is used extensively in making movies. Not forgetting that the Chicago Art Institute has found this grainless all-wood board an excellent material for backing and protecting rare works of art!

Try Presdwood yourself

Presdwood has scores of other uses, and new uses are being discovered week after week. Remember, too, that Presdwood is not only workable almost beyond belief, but that it positively will not damage tools.

Adaptable for any woodworking machinery, uniformly strong, and highly resistive to moisture, it can also be lacquered, painted, stained or varnished. And yet it requires no paint for protection.

Write for a large, free sample of Masonite Presdwood, and find out what it will do for you. It may be the very material for which you have long been looking. It may enable you to make a worthwhile improvement in your product, and at the same time lower your operating costs. Try Presdwood for yourself!

MASONITE CORPORATION

Sales Offices: Dept. 1211 111 W. Washington St.
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FOR PLAYHOUSES AND TOYS



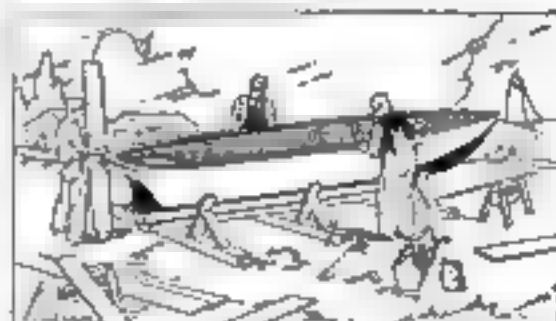
Mills: Lumber, Minneapolis

Masonite

PRESWOOD

Made by the makers of
MASONITE STRUCTURAL INSULATION

IN BUILDING BOATS



Our Readers Say—



The Woman "Talks Back"

THE article on "Are Women as Smart as Men?" was exceedingly interesting. I am not a psychologist, nor could I be scientific if I had to; but I am a woman, therefore I enjoy talking back.

"As Mr. Lecky says, women are 'newly freed in body, newly independent in action and expression.' That is true now for the first time in history. Isn't it a bit early to compare the achievements of the two sexes? Women's interest in the science of government has been a case of 'hanging her clothes on a tacky'—my



"I agree with Mr. Lecky that to get to the root of the question, we find it a matter of physical strength. But who shall say that barrier is eternal? When woman is far enough removed from the age-old barbaric customs that enslaved her body might there not be a different story to tell? I can remember when the mark of real ladyhood was a periodic fainting fit. Where are the ladies gone, anyway?

"Now to Mr. Lecky's point that women don't count large among the geniuses of the world because they can't want to be geniuses. That, too, is changing. Women still want to be sweethearts and wives and mothers, but the day of limited families has arrived, and women will soon find they can achieve their ideal of smaller families more scientifically reared, and still have years left for other kinds of creative production. Is it not possible that in the future some of the thirty-one even will be mothers? —A. R. C., Rochester, Minn.

Can You Answer This?



"I WISH some of our moon-shooters and planet-pelters that call themselves scientists would make a thorough study of Sir Isaac Newton's Third

Law of Motion, and then apply it to their high-powered sky-rockets. It seems to me that anyone with average intelligence could see that this method of

going to other planets is absurd. I do not think anyone would be so ignorant as to deny or doubt this old law of motion. Then if they believe in it, where in empty space will they get their resistance required to drive the rocket on? —C. C., Greenville, Tex.

A Challenge to Inventors

"YOUR editorial 'Why Not Keep Cool?' in the September issue offered a real challenge to inventors and engineers. How long before we can have summer cooling plants for private homes? This last summer, artificial chilling breezes comforted thousands of the country's sweltering theater-goers, and made August heat endurable for brokers in the New York Stock Exchange. From that it is only a step to imagine a day when the man who tends his household boiler in winter will be regulating his chilling coils in summer.

"It is perfectly possible—but, today, far too expensive. There are two main difficulties, as explained by ventilating engineers. When you club air, dew forms. Before you can blow cool air through a house you must take out the

dampness, and the only practical way to do it is to chill the air more than enough, and then warm it a little. Running the expensive apparatus overtime costs money. So does the elaborate system of ducts and fans required to circulate the cool air. Hence, private homes, hotels, and apartment houses still await large-scale refrigeration.

"Perhaps the future will bring some simplified means of house cooling. There is a grain of hope in one engineer's statement that, in theory at least, it should be possible to hook up an electric refrigerator to a summer house-cooling system."—Dr. A. M., Baltimore, Md.

Only 64.6 Percent American!

"I WAS absolutely thunderstruck at your selection of the thirty-one greatest masculine brains of modern times. I noticed that your list contained 64.6 percent of American citizens which, in my opinion, is a greatly exaggerated percentage of the world's genius." —A. R., Glasgow, Scotland.

Fine Sport, But Take Care!

"HAVE been greatly interested in the glider article, Flying Planes without Motors, in POPULAR SCIENCE MONTHLY for August, and I am hoping you can put me in touch with the American Glider Association, for we would like to start a club in the Hawaiian Islands. This is a fascinating sport, and we believe we have ideal country for it. —G. T. A., Honolulu, Hawaii, U. S. A.

"I am much interested in your article on gliders. Several young men in this vicinity are impressed by the wonderful feats of the German gliders, and we have decided to make a glider. I have interested two mechanics from Byrd Field, and they are willing to help us. We have decided to build a plane like those which more advanced students use, since we can get two or three pilots for instructors. The foreman of a lumber company has consented to get the lumber for us at a low price. We have an excellent location for flying and enough people interested to start a club. —P. V., Richmond, Va.

Pleasure from Tin Cans

"WOULD it be possible for you to induce Mr. Thatcher to give a further list of tin can toys than the ones he used in illustrating an article in POPULAR SCIENCE a few months ago? Having made a steam roller for a small lad, I found this work to be fascinating, and I should like very much to do some more of it.

"As a retired Army officer, I find that time hangs heavily at times, and I use a small shop as a recreation as well as for practical purposes.

"I have in mind a plan to aid the county and state nurses in their work, as I have done formerly, in providing small appliances which it is difficult for them to obtain for the poorer patients, especially the children. A simple toy, they tell me, goes a long way to ease a fretful little one, and simple mechanical toys are especially useful in their work. I regret that



our charities do not always consider that something pleasing to the eye may be of more value than something pleasing to the stomach." —J. B. D., Bel Air, Md.

All Joking Aside



"AMONG those who enjoyed the privilege of your 'Let Them Say' was Alfredo de Amarel, director, snake serum farms, B. Tablan, Brazil, who was quoted as follows: 'Alcoholic liquors are harmful to persons bitten by venomous snakes.'

Another argument for prohibition, I suppose. If so, shouldn't we pass a law making it a felony to be nipped by a rattler or struck by a copperhead? This is serious, I mean. —Dex as Dust, Tampa, Fla.

What Price Knowledge?

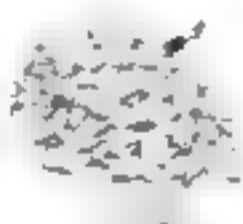
"YOUR readers' discussions of 'It' and personality plus have intrigued me to such an extent I feel it necessary to protest the notion that a cultured or versatile mind must necessarily be an interesting one.

"Perhaps you recall the story of Schopenhauer and his silent wager to drop a gold coin in the poor box whenever the officers at his table spoke of something other than women and horses. Schopenhauer was cultured, but his company was not much sought, nor were his thoughts conducive to good digestion.

"So, if you want to lead in conversation, leave science home and talk of old women, and politics. —F. W. B., Allentown, Pa.

A Loyal Friend

"I AM now seventy-eight years old and have taken your magazine since 1882. With the exception of some numbers which I burned I have all the copies since then, now on fire. Wishing you success. —D. W. B., Norwalk Conn.



Keep Cool, Gentlemen

THE letter of W. J. M., of Sarasota, Fla., taking G. H. T. from the hospital to task for saying that "only incidentally does a refrigerator act as a bacteria killer or inhibitor, got under my skin. I quote from Farmers Bulletin 373: 'It must be remembered that refrigerators are often dirty and that it may bring in putrefactive and other bacteria for most bacteria are resistant to low temperatures and are not destroyed by freezing.'

"While as a class bacteria grow best at a temperature of 86 to 95 degrees F., experiments have shown that few bacteria are killed by keeping them at temperatures considerably below freezing for months at a time. The average temperature of a refrigerator in the home is about 40 degrees, and this keeps the bacteria in a dormant state, but they will immediately begin to grow and multiply when brought to the temperature mentioned above. Would suggest that W. J. M. study up on his bacteriology." —G. S. E., Palmyra, N. J.

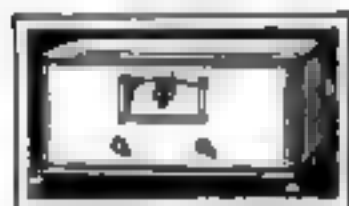
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Berkey & Gay

Radio

enters a new phase with the Balkite AC receiver



This set is sold by Berkey & Gay, Inc., 1111 North Dearborn Street, Chicago, Ill.



Balkite A-5—The Table Model. Walnut cabinet, by Berkey & Gay.

Balkite A-3—The same, in a simple, but slightly, all-metal case.

Balkite A-7—Housed in a beautifully hand-carved walnut cabinet by Berkey & Gay. Completely equipped, including dynamic speaker.

\$175.00 to \$450.00

Prices slightly higher
West of Rockies



For some time the problem of faultless reception has been solved—in the laboratory. To make this quality of reception available in a simple, practical, permanent set—that is the radio problem for 1928; solved by the Balkite AC set.

Radio fans who have heard the marvelous reception now achieved in the laboratory, and who are familiar with the complicated mechanism required to produce it, are amazed at the Balkite chassis. For here is that same faultless reception, but accomplished by means that engineering refinement has reduced to utter sim-

plicity, in a set that has the finality of a fine car.

Here, too, is AC without hum; a complete unit ready to operate from your light socket. It has push-pull audio, complete shielding, dynamic speaker power, a jack for reproducing records electrically. The circuit allows wide variation in voltage with safety to tubes.

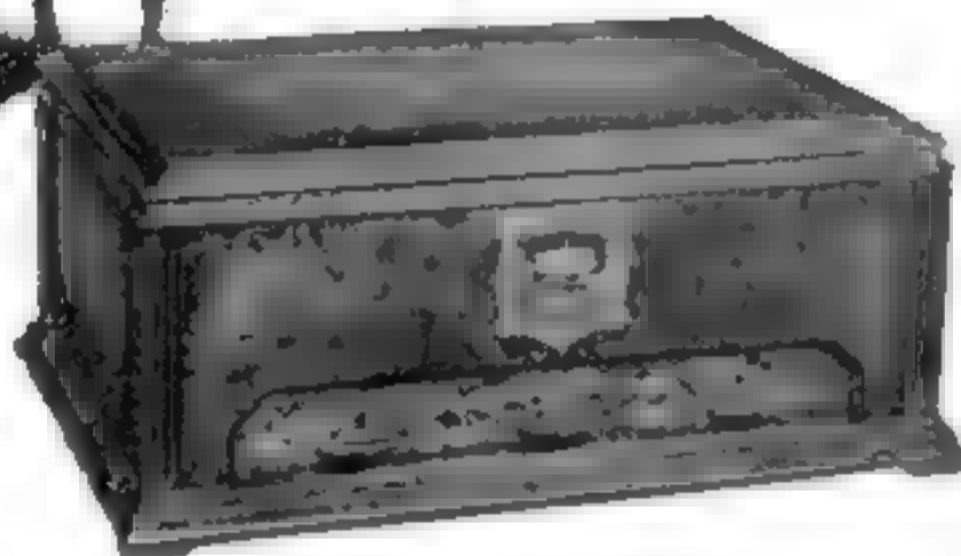
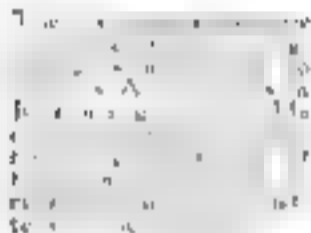
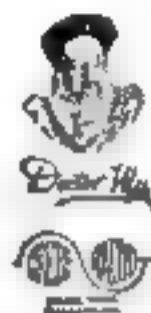
The cabinets are by Berkey & Gay; an exterior elegance to match interior refinement. The dealer will gladly demonstrate . . . Fansteel Products Company, Inc., North Chicago, Illinois.

FANSTEEL

Balkite Radio



Get it *Better* with a Grebe



It is to a comprehensive understanding of the exacting demands of those who insist upon something "just a little better" in every phase of life that the Grebe Synchrophase A-C Six owes its perfection.

It was designed for those who want something more than the mere convenience of alternating current, light-socket operation; for those who want, in addition to relief from battery worries, the intrinsic quality that has made the Grebe such an outstanding leader in every phase of radio development.

If you aren't satisfied with something

just good enough, you'll appreciate the tone quality, range and selectivity of this fine receiver; its freedom from A-C hum; illuminated single dial and other new improvements which truly enable you to "get it better with a Grebe."

A demonstration of the Grebe Synchrophase A-C Six will convince you of its superiority. Hear it today or send for Booklet P, which fully explains this new set.

Other Grebe sets and equipment: Grebe Synchrophase Seven A-C, Grebe Synchrophase Five, Grebe Natural Speaker (illustrated), Grebe No. 1750 Speaker.



GREBE

SYNCHROPHASE

A-C Six

RADIO

A. H. Grebe & Company, Inc., 109 West 57th Street, New York City

Factory: Richmond Hill, N. Y.

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Makers of quality radio since 1909



Dropping to safety by parachute may not be as simple as it looks. It depends on your physical equipment in most emergencies.

Are You Physically Fit to Fly?

U. S. Medical Authority Explains the New Scientific Yardsticks of Your Capacity to Pilot a Plane Safely

By L. H. BAUER, M. D.

IN THE wake of the epochal flights of the last eighteen months a great wave of enthusiasm for aviation has swept the country. Every boy sees himself a potential Lindbergh. Thousands of Americans have made airplane flights as passengers; hundreds of young men—and men not so young—have enrolled in training schools for pilots. People who should know what they're talking about predict that soon airplanes will become as plentiful as "firvers." This I doubt, although I do believe they will eventually supply a more

or less common means of transportation.

In all this talk about aviation and its future it has struck me as highly remark-

able how few persons give any thought to a phase of the subject, which, in my opinion, is of prime importance—namely, flying and physical condition. After several years' study of this question, during which time I have been in daily contact with flyers, I would say that if you wish to learn to fly, the very first thing you must do is to take a physical examination. Moreover, this examination cannot be an ordinary one such as you might take for a life insurance policy. It must involve so many different factors and so many special tests that its comple-

FOR more than six years Doctor Bauer was Commandant of the Army School of Aviation Medicine. Since resigning from the Army more than a year and a half ago, he has been Medical Director of Aeronautics for the U. S. Department of Commerce. In this capacity he has passed on the physical examinations of all civilian flyers applying for Government licenses—more than 10,000 in all. Simply and understandably he answers here the questions you have been asking about your physical fitness to fly an airplane.



Left: Testing the hearing of a candidate for pilot. The candidate is seated at a table, and the examiner is standing behind him, holding a small object (possibly a tuning fork) near his ear.

Below: Determining a candidate's reaction to high altitudes by subjecting him to a simulated high-altitude environment. The candidate is seated in a specialized apparatus, and the examiner is standing behind him, observing his reaction.



leaves no doubt of your physical soundness or of your possession of the highly special and attributes necessary to successful piloting.

Sub-mention of the physical examination of flyers as I have said, usually takes the form of criticism. Yet no strong prescriptive evidence that a physical examination, far from being just another obstacle placed in the prospective pilot's path, actually is a necessary preliminary to a training course in flying. I might cite the experience of the British in the World War. During the first year, British aviation recruits underwent no special physical examinations, other than the ordinary examinations given to all soldiers.

MANY men who had "washed out" as infantry officers were sent to learn to fly. As a result, of every 100 aviators killed, two were killed by the Germans and sixty by their own physical defects. After the adoption of a more careful standard for the selection of flyers and the institution of a system of medical supervision, this sixty was reduced within a year to twenty, and later to twelve. Accidents due to physical causes are uncommon now among our Army and Navy flyers as a result of careful selection and supervision.

I knew a famous flyer who was ill from grippe. He "doped up" on aspirin and continued to stay up nights on wild parties. Though begged by a flight surgeon not to fly on a certain day because of his physical condition, he disregarded the advice and went on what proved to be his last flight.

Another flyer was advised not to fly because he was unable to judge distance. He miscalculated his distance from a telephone pole a few days later and washed out his ship. Still another, whose name figured prominently in the headlines not long ago, was advised not to fly because of defective vision and inability to judge distance. He flew to his death about two weeks later because he was unable to distinguish his landing place clearly and misjudged his distance from it.

As a result of bitter experience corroborated by much research, practically all

countries now have almost the same rigid physical standards for flyers. They recognize that Nature never intended man to fly. Consequently, the man who goes into the air, where he is subject to conditions different from those on the ground, must possess unusual physical resources. Do not misunderstand me. A flyer need not be a superman. There are millions of young men in this country physically qualified for flying. It is interesting to note that transoceanic flyers applying for commercial licenses, including Lindbergh, Chamberlin, Brock, Gurnel, Acosta, Halderman, and Ruth Elder, met these physical standards without difficulty.

Why should flying call for a higher physical standard, and what factors are of special importance?

First, I would say, come the eyes. More men are rejected because of defective eyesight than for any other physical reason.

GOOD vision is vital to safe flying. The flyer must be able to distinguish objects clearly, such as the character of the terrain, or other planes in his vicinity. More than one flyer with defective vision has been killed because he failed to see a plane about to land as he was taking off, or vice versa, or because he missed seeing one in the air and collided with it. He must be able to read his instrument board and his map. All this requires eyes that can see at a distance, that can change focus quickly from far to near, and that permit peripheral vision as well as central.

These terms probably require explanation. The normal individual, when looking straight ahead, sees clearly what is directly in front of him. This is central vision. At the same time he is aware of objects at either side, although they are

not seen so clearly. This is peripheral vision. If a person lacks that peripheral vision—in other words, if his fields of vision are narrow—he is unable to see anything unless he is looking directly at it, much the same as a horse wearing blinders. It also happens that when a man has these constricted fields of vision he is likely, too, to be suffering from what is known as "night blindness," in which case he would better be home before dark.

But why cannot a person with defective vision wear glasses while flying, as he would of driving an automobile? Some flyers do, but it is a severe handicap. For one thing, glasses must be worn under goggles, which means that the flyer is looking through two panes of glass.

ALSO the lenses of glasses are small in comparison with the lenses of goggles. So long as the flyer is looking straight ahead he has adequate vision, but when he turns his eyes to the side his vision becomes blurred and distorted because his glasses do not cover his whole visual field. Now what about having proper correcting lenses ground in the goggles? This has been tried, but certain corrections cannot be ground into a lens the shape of a goggle lens. In such cases, a corrective insert is slipped into the frame with the goggle lens.

This insert is open to objections because it, again, corrects only about two thirds of the field of vision, giving blurred vision for the other third; it easily becomes dirty and is hard to clean. Furthermore, if a flyer wearing correcting lenses in his goggles should get a smear of oil on his lenses when landing, he would be in a dangerous predicament. Either he would have to tear off his goggles and deprive himself of his correction or leave the smeared goggles on and perform with blurred vision one of the most delicate operations of flying.

SO IF you want to learn to fly with a view to becoming a military or commercial transport pilot, you must have normal or 20/20 vision, normal visual fields, and a moderate amount of accommodation (the power to change the focus of the eyes from far to near). If you wish to become an industrial pilot and carry mail or freight, but no passengers, your vision may be slightly less, or 20/30, and if you wish to fly for your own pleasure your vision may be still less, or 20/40. By these figures is meant the ability to see at twenty feet what should be seen at twenty feet, thirty feet, or forty feet as the case may be.

The ability to judge distance, while dependent in part on experience, is dependent chiefly on the eyes. Every time you take off or land it is necessary to judge exactly your distance from the ground, and from obstructions such as trees, planes, buildings, telephone poles, and wires. Your ability in this particular is tested by an ingenious apparatus invented by Dr. H. J. Howard and modified later by Dr. F. Dolman, in which, while looking through a window in the front end of a box placed twenty feet away, you endeavor by means of a cord

and pulley to place two 3.8-inch rods side by side.

There are six little muscles that control the movements of each eye. These muscles are so coordinated and balanced in the normal individual that they cause the two eyes to act in unison and we see only one object. When the muscles are not properly balanced, either we see double or else we make a constant effort to maintain single vision. This effort is fatiguing; it causes headaches, which lead to inattention and carelessness. The balance of these muscles is closely associated with defects of vision and with the judging of distance. You can appreciate that disturbances of this balance may be serious in the flyer. The "ocular muscle balance," as it is called, is tested by means of prisms, which indicate the strength and weakness of the various muscles. Certain tests are required of all pilots, but the most complete examination is made of military and commercial transport pilots.

COLOR vision comes next. Its importance may be appreciated when you recall that airplanes carry navigating lights, airdromes have colored lights, signaling is done with colored flares and panels, maps are often printed in colors, and perhaps most important of all, that different shades of brown and green seen on the ground indicate to the flyer the character of the terrain. This latter is particularly important if he has to pick out a landing field.

Finally, the eyes are examined to determine whether any disease of the eyeball or lids would interfere with clear vision or cause the eyes to water easily thus producing dangerously blurred vision.

The next part of the examination, and perhaps the least important, pertains to the ear, nose, and throat. The candidate should be free from any disease that would, under fatigue or exposure, "light up" in an acute infection; and he should have no marked obstruction to breathing. Normal hearing is not essential but he should be able to hear his mechanic when he says "contact" or "switch off," and for certain classes of flying he should be able to hear radio signals.

Since the plane of equilibrium of a flyer is constantly changing, he must be able to orient himself regardless of position. Equilibrium is a function of several organs. Eyes play an important part, so do the ears, and also the sensations received from muscles, joints and internal organs. The effects of gravity also play a part. During the World War and for a time afterward, a person's equilibrium was tested (for flying) by a turning chair. This now has been replaced in the Army and for commercial flying by a much simpler test. The candidate is



Measuring a prospective flyer's ability to see clearly and judge distances accurately. This prism instrument tests the balance of the muscles that control the eye movements.

told to stand on one foot, flex the other leg at a right angle at the knee (keeping it away from the other leg), close the eyes, and maintain the position for fifteen seconds.

The candidate is then given a general physical examination. Particular attention is paid to the heart, circulation, lungs, and kidneys, as organic disease of any of these lowers resistance, becomes accentuated by fatigue, stress, and exposure, and may develop serious crises.

Structural defects are looked for, such as hernia (rupture), and limitation of motion of joints. The flyer should have all his extremities, free motion at the

shoulder, elbow, and hip. Slight limitation of motion in the knee is not disqualifying and even fifty percent limitation may be permitted in the wrist and ankle.

Abnormalities of the thyroid gland, also, are cause for rejection, because of the serious constitutional effects of certain types of thyroid disease.

As important as the eyes is the nervous system. The person with an unstable nervous system does not last long as a flyer. Of course, organic nervous disease at once disqualifies. One would not think of sending into the air a person afflicted with a paralysis, a mental disease, or epilepsy. In addition effort is made to eliminate the neurotic persons. Experience has shown that they go to pieces quickly and rarely make good flyers.

Flying is attended by a physical and nervous strain. This

may not show in a sound, stable individual who takes care of himself and who flies not more than four hours a day, but in the unstable type, in the man who frequently dissipates, or who is flying five and six hours day after day, it manifests itself in irritability, loss of interest in work, morbid fears while flying, and even a dislike of going into the air. The man loses weight, sleeps with difficulty at night, and when he does sleep, dreams of air accidents. There were countless such cases on record during the World War. Peacetime flying is less likely to produce this "stale" condition, but even here it will develop in certain individuals.

The ideal age for flying is the period from twenty to thirty years. You may make a successful flyer if you learn after thirty-five, but the chances are slim, and these chances rapidly diminish as your age increases. Flyers who learned when young and have kept in good physical trim and have kept up their flying remain good flyers, but lacking the keenness of youth, they are not fitted for combat flying, for example. There are flyers over fifty who learned to fly late in life, but such men are not fitted for the wear and tear of commercial aviation. Middle age brings a development of conservatism, a slowing of reaction time and a loss of physical resiliency that do not go well with flying.

Commercial flying is not much concerned with high altitude, but military flying is. Combat flying is done at 18,000 to 20,000 feet. Not all men react equally well to high altitude, and no man should fly above

(Continued on page 169)



U. S. Army planes in formation flight. Flying wing is wing tails or nose or judgment of distance. A slight error may mean a collision.



Here is a tragic picture of what frequently happens when a man who is suffering from some physical or nervous ailment attempts to operate an airplane.

PEERING into the future is, for most of us, a mighty chance business. For Nikola Tesla, world-famous electrical wizard and inventor extraordinary, it is second nature.

He is an enigma, this man Tesla. His astonishing discoveries and his prophetic visions have established him in the popular mind as a genius and a fantastic dreamer. Turned into practical form in his induction motor, high voltage transformer, and system of alternating current transmission, his fancies have brought him fame, fortune, and a place among the immortals.

At times they have subjected him to ridicule. In the dozen years since a catastrophe halted his last great project to supply the world with power by wireless—he has spoken only rarely of his projects. But at last he has broken his silence for the readers of *POPULAR SCIENCE MONTHLY*.

Within three years, he told me, his "World-system" for transmission of wireless power through the earth should be in commercial operation. Other wonders, too, he described—a "flying airplane," his latest invention, and a powerful new turbine motor which, he said, has but one twentieth the weight of an engine as now designed. It was a staggering word picture of the future that Tesla gave me.

BUT thirty-five years ago people derided as impossible Tesla's prophecy before scientific societies that ships in distress at sea would call for help by wireless apparatus. It was characterized as "inventive lunacy." Many of these unbelievers lived to see wireless summon rescuers to lost explorers stranded on an Arctic ice cake.

Thirty years ago people thought Tesla was indulging in a wild fancy when he built a model for a crewless vessel. Yet today the British Navy is experimenting with *H. M. S. Centurion*, a full-size

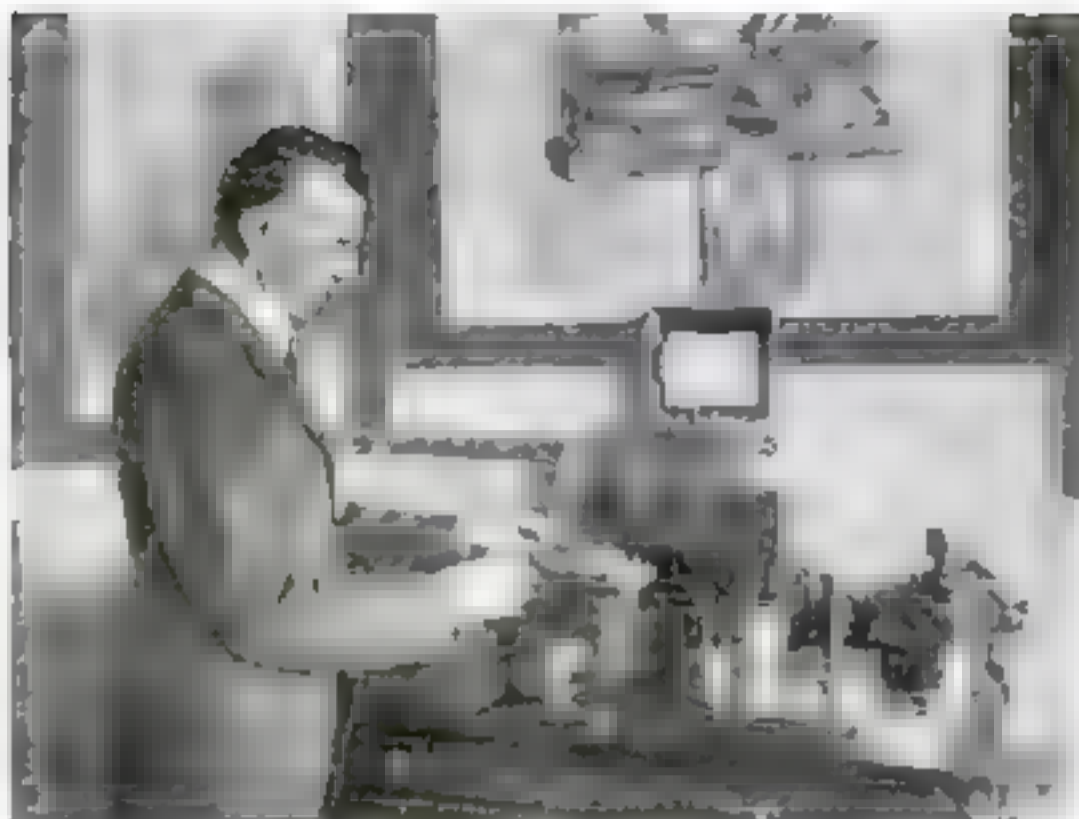
warship without a crew, controlled entirely by wireless. Germany is doing the same with the former battleship *Zachringen*. Airplanes and automobiles have been run by radio control.

Twenty years ago, when Tesla designed an automobile to be propelled on water, land, or through the air by explosive jets

heated to cook with and light to read by. Flying airplanes whizzed rectly upward and dart across country at many miles a minute. Jet-driven airships will cross oceans, but Tesla draws the line at moon rockets.

To talk with Dr. Tesla is to become acquainted with an extraordinary life packed with adventure into uncharted realms of knowledge. Ever since his boyhood, in the village of Smoljan, Jugo-Slavia, his mind has been hunting in unexplored places. As a student at Gratz, Austria, he astounded professors by his prodigious mental feats. Once he won a wager with a fellow-student by reciting an entire volume from memory!

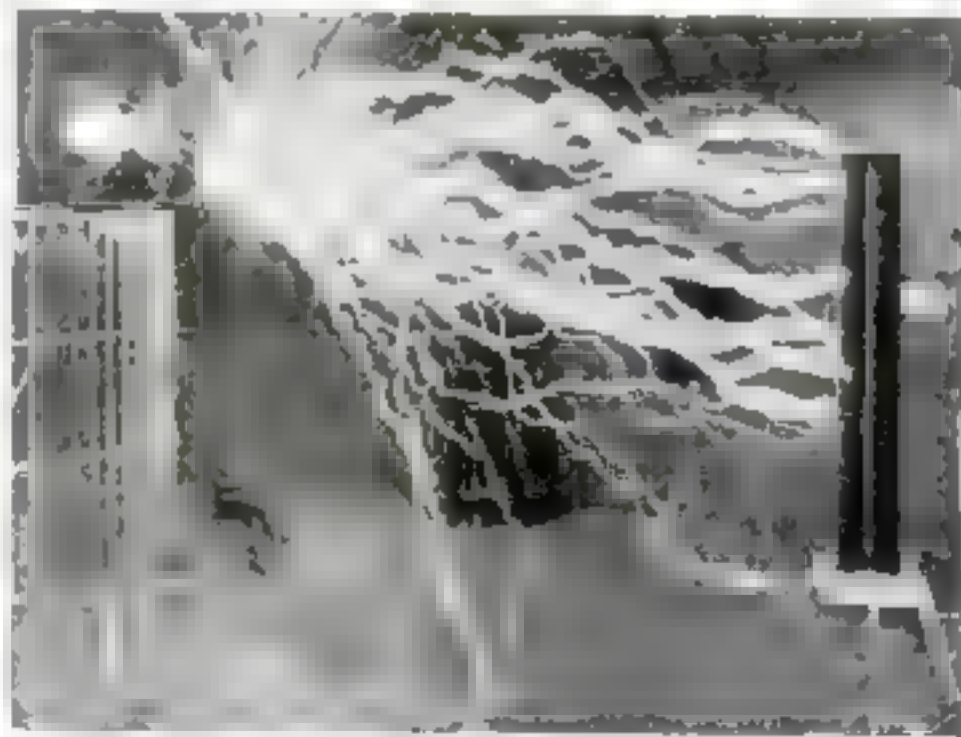
ONE day the students received from Paris a Gramme motor, an early type that sparked badly. Tesla suggested that a motor might be produced without the brushes that transmit electricity to the spinning rotor, thus eliminating the trouble. It couldn't be done,



Dreamer, prophet and practical inventor, Nikola Tesla holds a high place among the world's creative geniuses. At the age of seventy-one, he still labors in the laboratory to turn his visions into useful forms.

A Famous Prophet of Science Looks Into the Future

By ALDEN P. ARMAGNAC



Crackling artificial lightning of millions of volts produced by Tesla at Colorado Springs in 1899. The noise of it was heard thirteen miles away.

his professor of physics told him. His classmates jeered.

Less than five years later, Tesla invented just such a machine, the "induction motor" which brought him fame. Without brushes, it operates on the principle of the "rotating magnetic field"—a sort of magnetic cyclone, discovered by Tesla, that grips the armature and whisks it.

After this discovery, described by such a hard-headed engineer as H. W. Buck, president of the American Institute of Electrical Engineers, as "one of the greatest feats ever performed by human mind," Tesla came to America. He invented the "Tesla coil" or "Tesla oscillation transformer." Today every wireless transmitter and receiver embodies this great principle, which has also been put to innumerable other uses in science and industry.

With it, he turned ordinary electricity into crackling lightning of millions of volts. Waves of thunderous discharges struck the ears of visitors to his Colorado Springs, Colo., wireless plant erected early in 1890; they could even be heard in Cripple Creek, thirteen miles away.

IT WAS there that Dr. Tesla carried out his scheme of sending power by wireless through the earth. Not "wireless" such as we know today as radio, was this. He transmitted, not radio waves through the air, mostly wasted, but electric currents through the ground. By this method, he told me, he transmitted enough power around the earth to light several hundred incandescent lamps, and proved that power in industrial amounts could be transmitted to any distance with an efficiency as high as ninety-nine and a half percent.

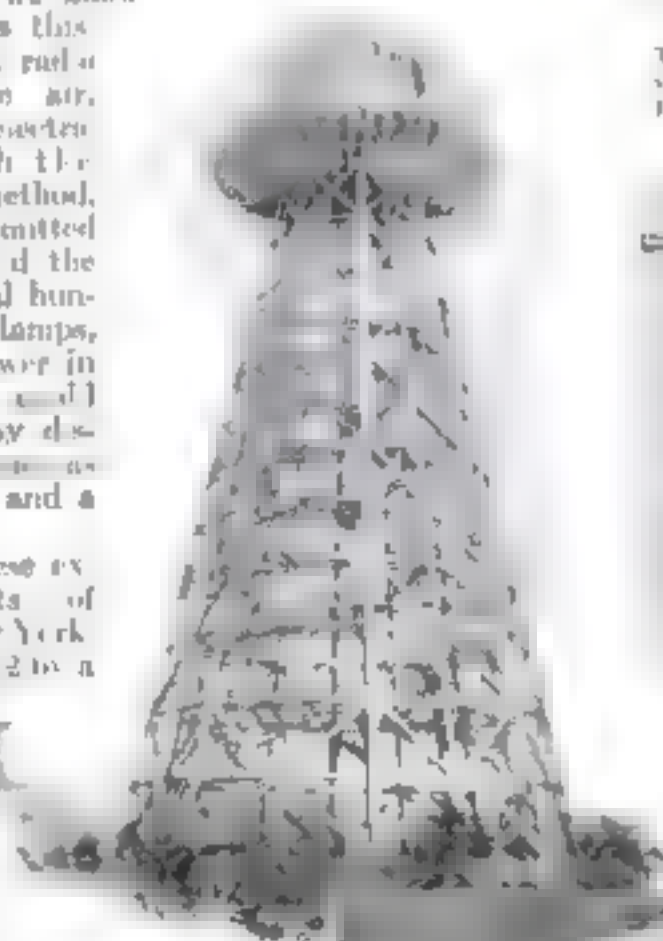
As a result of these experiments, residents of Shoreham, L. I., New York were mystified in 1902 by a massive tower of steel rising nearly 300 feet in an open field. "Tesla's tower," they called it; for rumor had it that from it Tesla would hurl thunderbolts into the earth.

In reality the tower was Dr. Tesla's "Magnifying Transmitter," intended to feed electric power into the earth. At its top, a globular

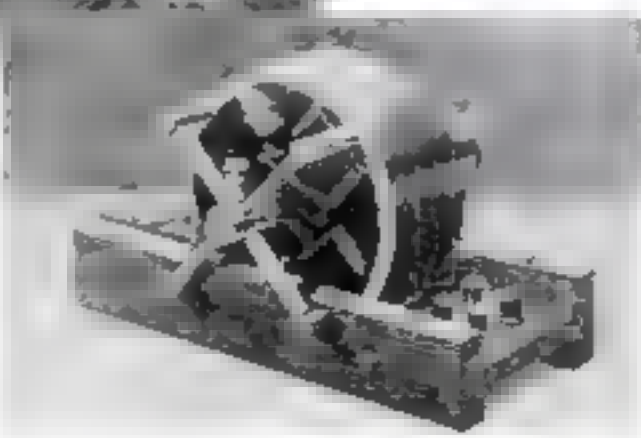
dome was to store momentarily, before hurling into the earth, tremendous currents produced by a "Tesla oscillation transformer" in the tower's center. Nearly completed was the odd structure, when a dynamite blast of unknown origin turned it into a twisted mass of ruins.



Remains of Tesla's tower, the site of his experiments in sending power by wireless through the earth. The structure was destroyed by dynamite blast of unknown origin. The structure was destroyed by dynamite blast of unknown origin. The structure was destroyed by dynamite blast of unknown origin.



Above: The 204-foot 'Tesla's tower' at Shoreham Long Island, destroyed by dynamite blast in 1914. Its purpose: Tesla envisioned electric currents into the earth for transmission. At the right is shown the induction motor, one of Tesla's greatest discoveries.



The 'Tesla coil' or 'oscillation transformer' whose principle is embodied today in every wireless transmitting and receiving set.

Today he is ready to build a new and larger plant. And he is confident that by 1931 it will be in commercial operation. This plant was also to broadcast speech, and pictures by a system of daylight television without moving devices outlined by him in 1893.

"Contrary to popular opinion, which has identified my 'Magnifying Transmitter' with thunder and lightning," Dr. Tesla said, "it operates in silence. There is no halo of escaping electric flames, or other visible evidence of activity—except that a person within a hundred feet of the tower will notice small sparks, prickling of the skin, and bristling of the hair."

A fantastic dream? Perhaps—but Tesla has dreamed such dreams before and seen them come true.

BESIDES his world power scheme, Dr. Tesla says he is devoting his time chiefly to his vertically rising flying machine. This aerial flyer is to weigh less than 200 pounds, and to occupy no more space than a seven-foot cube. It is to rise to a great height at a rate of from one to two miles a minute, and may attain a horizontal speed as high as 400 miles an hour, power being supplied by an exceedingly light oil-burning motor, a modification of a steam turbine Tesla invented. An all-metal framework and the absence of gasoline guard against fire hazard. Additional safety is to be attained by a parachute of new construction.

Unlike inventors who work with the tedious process of trial and error, Tesla visualizes his inventions, full-fledged, even to the smallest detail. One evening he was walking with a friend through the City Park of Budapest, quoting from a book of poems he had learned by heart. In the middle of a line he broke off, seized a small stick, and scratched a rough picture on the sand. It was his induction motor, revealed to him in its entirety! And the plan he drew was the same that, seven years later, he presented to the American Institute of Electrical Engineers.

EQUALLY spectacular was his demonstration of a wireless lamp, at his Grand Street laboratory in New York City. At three o'clock one morning, when he and his workmen were ready to quit for the night, Tesla decided that a certain high-frequency generator he had been constructing was ready for the test of a new lamp that would light without wires. He sent his workmen outside while he made ready the apparatus. All that remained was to close a switch.

When the workmen returned, Tesla strode to the middle of the laboratory. In each hand he held a long glass tube, exhausted of air. "If my theory is correct," he told his assistants, "when the switch is thrown in, these tubes will become swords of fire. Darken the room and close the switch."

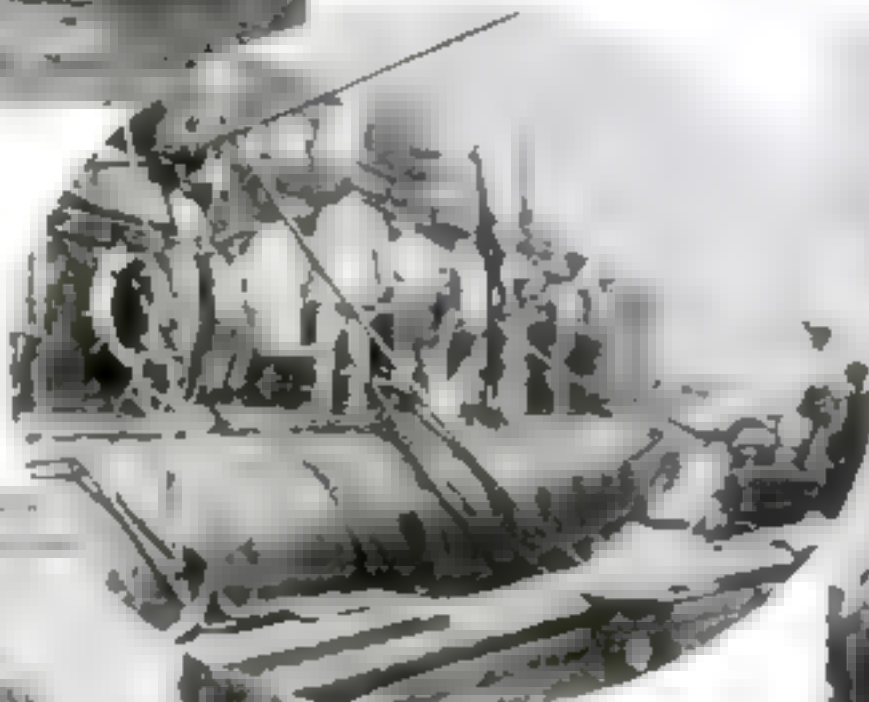
The lights went out, and there was a faint click. (Continued on page 176)

Camera News of

*The Raising of Submarine
Launched — World's Largest
Advances in Undersea Rescue,*



Though the entire crew of the Italian submarine *F 16* perished from suffocation when their ship was rammed and sunk by a destroyer in the Adriatic Sea a few weeks ago, the successful raising of the wreck in thirty-four hours was praised by experts as a remarkable feat of salvage. Huge floating derricks lifted the hull from the bottom. Above the submarine being towed to drydock.



Preparing to open the *F 16* in dry dock. The submarine was only partially flooded, thanks to swift work of the doomed crew in closing water-tight doors. The weight lifted was 120 tons.



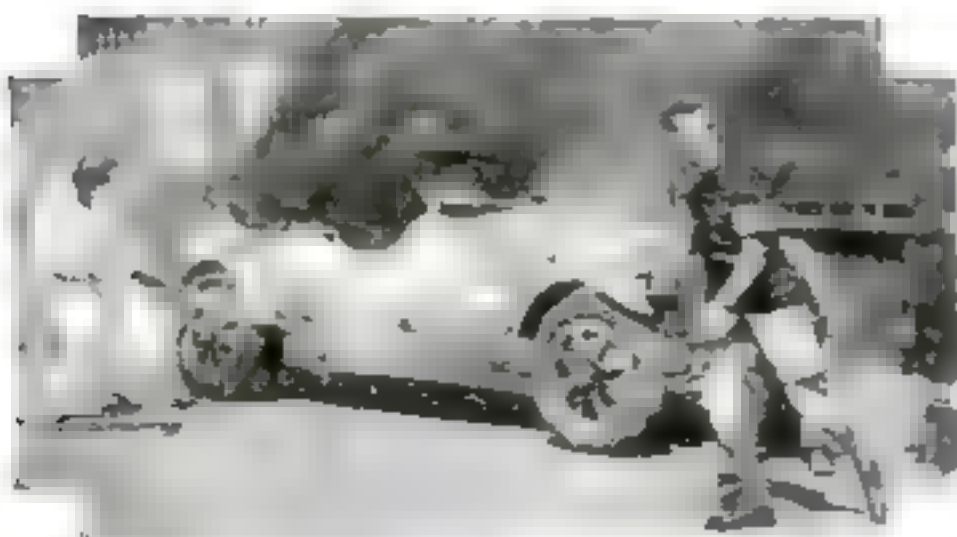
X-rays five times as powerful as those used in medicine are produced by this giant million-volt tube, largest in the world, assembled at the California Institute of Technology in Pasadena. Glass jars fastened one on top of another form a tube twenty feet high. For safety it is controlled by switches in a concrete tunnel, with mirrors for observation.



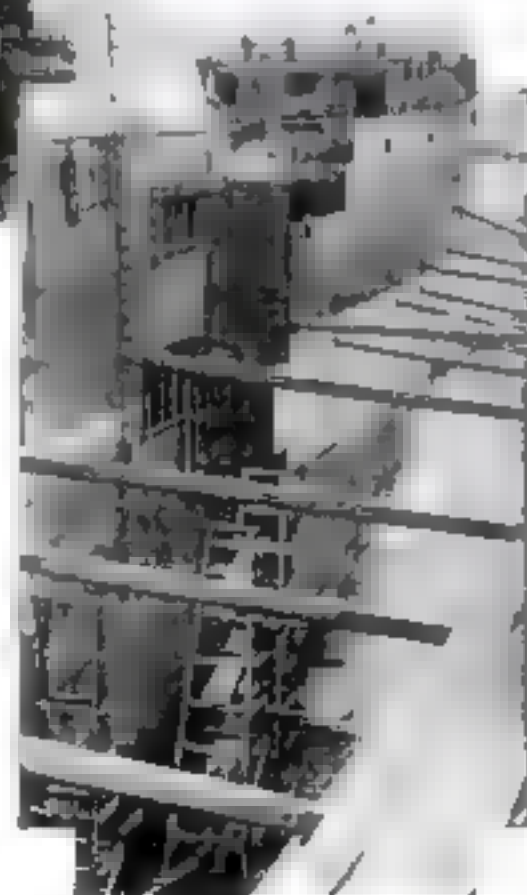
An unprecedented feat of marine engineering was accomplished recently in Belfast, Ireland, when half a motor ship was launched then fastened to another half to form a complete vessel. Last year the liner *Lochmowner* ran aground and broke her back. The badly damaged fore end was cut away. A new front half then was built and successfully launched to join the stern. The picture above shows this new section completed and ready to be sent down the launching ways.



Above: The after half of the *Lochmowner* after being cut in two. Made water-tight, this half was floated from Liverpool to Belfast where it was joined to the new fore half. The view at the right shows how the two portions of the *Lochmowner* were brought together.

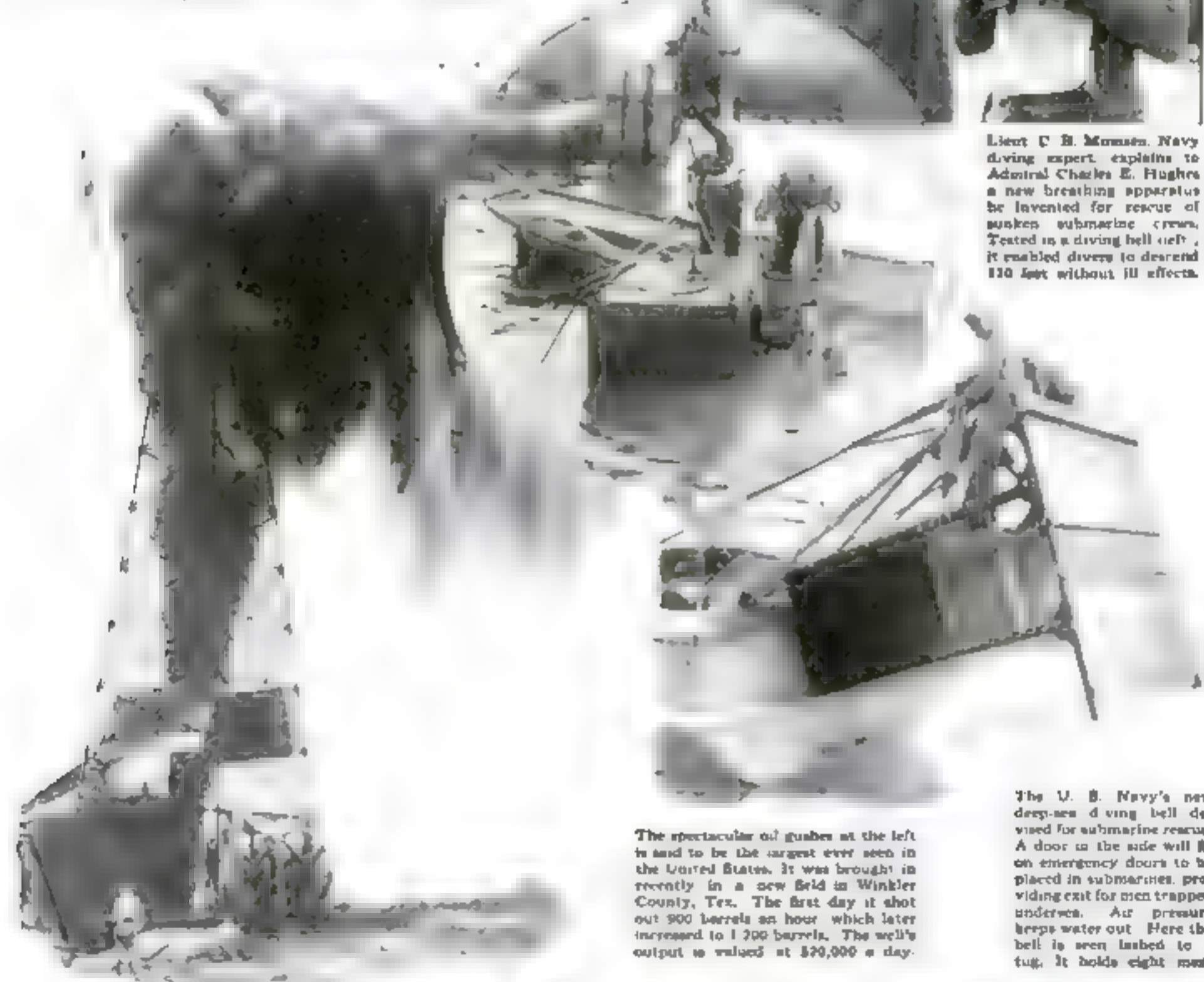


Left: A thrilling moment during the recent 410-mile motor road race for the International Tourist Trophy at Belfast, Ireland. The famous British speed king, Capt. Malcolm Campbell, is seen trying to extinguish a blaze which enveloped his car during the race. The damage caused by the fire forced him to retire, and the great contest was won by Kay Don, British driver.



Unusual Events

F-14 — How Half a Ship Was X-Ray Tube — The Latest Television, and Color Movies



The spectacular oil gusher at the left is said to be the largest ever seen in the United States. It was brought in recently in a new field in Winkler County, Tex. The first day it shot out 900 barrels an hour which later increased to 1,200 barrels. The well's output is valued at \$20,000 a day.



Lieut. C. B. Mommson, Navy diving expert, explains to Admiral Charles E. Hughes a new breathing apparatus he invented for rescue of sunken submarine crews. Tested in a diving bell (left), it enabled divers to descend 110 feet without ill effects.

The U. S. Navy's new deep-sea diving bell devised for submarine rescue. A door in the side will fit on emergency doors to be placed in submarines, providing exit for men trapped underwater. Air pressure keeps water out. Here the bell is seen lashed to a tug. It holds eight men.



Newest radio motion picture machine, with Dr. Frank Conrad, the Westinghouse engineer who directed its development. The scanning disk, heart of the apparatus, is directly in front of him.



Another new system of color movies. The inventor Frederick Thomas O'Grady, of Newark, N. J., holds in his hands the secret of the invention, a color filter in the form of a gelatin disk.

Young Jim

By EDMUND M. LITTELL

A DISTINGUISHED oriental scholar, Prof. A. H. Sayce, has just revealed that the first iron ever used by man fell from the sky. It was iron extracted from meteorites. Ancient Babylonian documents more than 4,000 years old, recently unearthed, describe it as the "metal of heaven." In that far-off day began the romance of the "iron age" which has culminated in the annual production of almost 100,000,000 tons of steel. In this story the author of "Widge" and "Fire Shy" gives us another thrilling picture of the magic of flaming metal.

expense of chipping floor at the rear. He was boss of the whole shebang; the entire half-mile length of high-roller building that resounded with the noises of cold-steel working on hot was under his stubby thumb. Yet the "Let's go!" of J. Orcutt Dustin, 2nd, added consternation to amazement and caused him to flee.

Because he knew J. Orcutt Dustin, 2nd, just as every other man inside the high wire fence of Midwest Steel knew him. They all talked about him and his deeds, some of them with amaze, some of them with awe. He was the son of James O. Dustin, the "Old Man" of Midwest Steel. To him would eventually come the fabulous wealth that five thousand men were making in the trainsheds of buildings that made up the mill. The heir-apparent to a princely kingdom, and at the age of twenty-seven years the hardest work he had ever done, barring a brief period in uniform, was the steering of a polo pony or a high-powered automobile. Why, the talk was that he even had a level man to help him put on his pants!

THAT was the man who had slipped himself into the dirtiest job in steel while Sam Thurber stood by helpless. For Sam had aided and abetted him in his unsuspected purpose. Innocently, of course; otherwise it would not have happened. He had thought and dreamed that J. Orcutt was having one of his jokes.

As a matter of fact, Sam should have been suspicious from the first, for the very hour of their meeting had been an ominous sign. Eight A.M.—that was four when J. Orcutt Dustin, 2nd, was supposed to be hitting the high spots along the sleep route. Certainly he had never before appeared on the plant until well after noon. But Sam had been too busy to think about it at the time. The shift was changing and there was an important rolling to be taken care of. And their collision, just outside the door of his office-shanty that squatted in the front corner of his building must have knocked the sense clear out of him.

What the "Old Man" began. "I beg your pardon," said the other, and Sam finished his remark with a laugh. He would have recognized that voice in a darkened room. He liked the Old Man's son. The memory of his first inspection trip, as a wide-eyed boy with his hand in his father's, was still fresh in his memory. So he went on with a chuckle.

"Who got you up before breakfast?"

THEY made an oddly assorted pair as they stood there—a polished bar beside a rusty chunk of bloom. J. Orcutt was a six-foot specimen of the kind of young men who are seen mostly on the advertising pages of magazines, immaculate from felt-hatted head to shining brown toe; Sam resembled nothing so much as a five-foot chunk of one of his own square blooms, his workaday clothes and battered derby covered with the dust of his job and a stubble of beard on a face that appeared to have been gouged out by one of his chipper's chisels. But J. Orcutt was not one to notice such discrepancies, which was one of the reasons why Sam



J. Orcutt Dustin, 2nd, millionaire's clothes and all, took a look at the dirty job that was offered him, grinned at the silent group that stood near by, and said "Let's go."

DIRT? The inside of a smokestack is a white porcelain tub compared to the cinder-tunnel that crawls beneath the soaking-pits of Midwest Steel. Heat? The breath from a stack's mouth is a cooling zephyr beside the blast that radiates from those incandescent rooms of hell. Yet J. Orcutt Dustin, 2nd, in millionaire's clothes and all, took a look at the job that was offered him there, grinned at the silent group that stood near by, and said "Let's go!"

Sam Thurber was flabbergasted. He could find no word, either of denial or acceptance, only a grunt, and while the strides with which he took himself away from there were no more hurried than usual, he had the feeling of one who fled.

It was his own kingdom, too. His word was law at the soaking-pits, as well as at the gigantic clothes wringer of a blooming mill behind them, the huge hydraulic shears further back, and the



The hardest work he had ever done was the steering of a polo pony or a high-powered automobile. Yet, apparent to a princely kingdom, to him would eventually come the fabulous wealth that five thousand men were creating in the trainbeds of buildings that made up the mill.

liked him. The brown eyes that always had a light of good humor dancing in them looked down upon him soberly and he replied, drawing, "Not a soul."

Then Sam poked the line that always drew a grin. "Well, well! Then maybe you're out pickin' a job for yourself this mornin', and waited for the grin that always came."

It did, together with—"How'd you guess it?" and their little game was on. Sam replied, with a look of great concern, to the greatly worried effect that he hoped J. Orcutt wouldn't take his job away from him. He had a family to support and seventeen children, and

"All right, I won't," J. Orcutt assured him. "I've decided. Though that you can't get along another day without my valuable services."

There, if Sam had only realized it, was where he should have re-de-stepped. But at the time he had concluded that the young man wanted to play a little longer, so he went on—the bigger fool he!

"WELL now, I appreciate that," he said with sober gratitude. "Let's see," thoughtfully. "We got a five-hundred-foot roll table that needs greasin' a couple o' times a day," with a mischievous glint in his upward glance, "or—by golly, I got it! Pete Reznik needs a helper on the soakin'-pits. How 'bout that?"

Pete Reznik always needed a helper on the soaking-pits. He himself had been on that man-killing job for eight long years and refused to take any other, but in all that time no man had ever been found who would stick there with him. They came and worked and faded away—sometimes after an hour and without asking for their time—sometimes after as long as a week. It was the hottest, dirtiest job in steel, and only Pete Reznik, the dried-up rick of skin and bones, had ever withstood its punishment. He stuck working over the open mouths of those heat-soaked furnaces and inhaling their hellish breath as though he were asbestos, inside and out.

Just to imagine J. Orcutt Dustin, 2nd, working at such a job was enough to cause a laugh. To think of him doffing his swell clothes and wrapping a handana around his face so that only his eyes were exposed, and those behind blue glasses, was stretching the imagination to the limit. To picture him standing over a half-opened pit and with poker and hoe above the mess of accumulated slag and scale down through the cinder-hole in the center of a floor ten feet below; to conceive him, sodden with sweat and caked with the clouds of dust that soared up on the wings of heat, closing the cinder-hole again and relining the floor

with barrow-loads of color breeze, then diving into the long, hot tunnel beneath and hauling away the stuff he had poked out—it was absolutely ridiculous!

So utterly nonsensical was the suggestion that when the lad replied with his slow-voiced—"All right, I don't care if I do," Sam Thurber roared with delight.

That was one of the things that made Sam—and not a few other men about the plant—like the lad so well. He always gave them amusement. No one expected him to do any work. Why should he? No one had had anything much to say when he had come home from college with his daddy's name parted in the middle, either. Well, not many. He was a gentleman, and always would be—the kind of a gentleman you read about. He liked to play, here and there and everywhere; he enjoyed living, and never did anything to be ashamed of. When he was at home he would visit the boys once or twice, and if any of them were hurt or had a sick one in his family there was always something nice from J. Orcutt. Nothing stuck up about him, in other words, so if he wanted to play along with this little joke, let him. Such was the way Sam figured—then.

Well, said he when he had had his laugh, "nothin' like startin' in right away, is there? Come on!"

So in our good-natured innocence do we hang ourselves—and with what consequences! For Sam actually led him around to the working side of the soaking-pits, figuring that J. Orcutt would take a look at the telephone booth of an office with its bench and its blackboard outside, close a bit with the heater and his gang, then stroll on about his business. But he did not. His eyes were all for the scarecrow that was Pete Reznik working in the glow of light that shone up out of a pit, then he stripped off his coat and vest and said—"Let's go!"

SMALL wonder that consternation bestrode Sam Thurber as his short legs took him back along the floor of steel plates, down a six-foot flight of stairs, and across the heat-dried floor of earth beside the hot wall of the rearmost soaking-pit, office hood. It was bad enough to shoulder the ordinary cares of getting out the tonnage, but to have the Old Man's son on his pay roll besides—

He stopped automatically, warned not by the gong of the crane but by the blast of light that burst upward to illuminate the sooty girders overhead, and waited until the crane pincers had hoisted a seven-foot block of white-hot, scale-dripping steel from an opened soaking-pit, swung it across his path and lowered it, small end front, onto the head end of the roll table. Those things were known to slip out of the tongs that gripped them; just

suppose one of them dropped on top of J. Orcutt Dustin, 2nd?

On again, ignoring the heat from the ingot, which the roll table was already bouncing back toward the shining, water-cooled rolls that waited to knead it into the snake of a bloom. Confound the lad, anyway! Why couldn't he have taken the thing as the joke it was intended to be?

On the other side of the building, with a clear path before him, he increased his pace. To his left, on the narrow gage track that lay along the foot of the five-hundred-foot wall that was the inside edge of the half-buried soaking-pits, a train of ingots fresh from the open hearth was waiting to be stripped. Normally he would have stopped and raised some hob with the stripper crane for not being at work, but now—an idea had seized him. In his office was a telephone, and, by the twenty-four chambers of bell that he housed, he would get the Old Man on the other end of it!

"Gimme the Old Man," he growled into the mouthpiece, and when the sleepy voice of the night operator informed him with dignity that Mr. Dustin was not yet in his office—"I don't care where he is; I want him!"

James O. Dustin was hard to get at. Sam had to fight with two or three people in the great house on the other side of town, but he was determined. At last a gruff "What d you want?" came over the wire and he spoke his piece as gruffly.

"I want you to come out here an' take your boy off my hands," he barked, unmindful of the position of the man he ordered around.

"What for?"

"He's took himself a job, an' I don't want him."

"Why not?"

Sam Thurber lost what little patience he had left. "I'm runnin' a bloomer and Jim Dustin!" He snapped it as one man to another, not as employer to boss. "I'm busy gettin' out tonnage. I ain't got time to be watchin' any kid o' yours. You come out here an' get him!"

"You gave him the job, didn't you?"

"No, I didn't. I showed it to him."

"What job is it?"

"Cinder monkey."

"And he took it?"

"He said 'Let's go!' the damn' fool, an'—"

"Well, let him go," was the decision of the voice that made men jump, and the click of a severed connection shut off a deep-chested chuckle.

Hang! A receiver was slammed onto its hook as though it were a club descending upon a head. They were both alike, those unmentionable Dustins. Father and son—dog-gone his unpertinence!—they took what they wanted. The nerve of him, walking into his place and slipping it over on him like— He stopped abruptly. Maybe it was still a joke. Maybe J. Orcutt had taken up his coat and left. Sam Thurber streaked hopefully back over the familiar roundabout path.

It was no joke. It was a serious business, and J. Orcutt Dustin, 2nd, was working at it. The heavy brick ceiling of pit Number Seven had been pulled back a few feet on its four wheels and there, in the glow from the partially cooled furnace beneath, were two figures, not one.

IT WAS easy to tell which was which. Pete Reznak was dressed for the job, J. Orcutt Dustin was not. Blue glasses, yes, but there the resemblance ceased. The handkerchief he wore over his face was white, or showed signs of having been; the same applied to his shirt. From the waist down he was invisible for they worked over the top of a corrugated iron shield designed to deflect a little of the heat that gnawed at them, but Sam could imagine how those once immaculate trousers and shoes looked.

And he was working—hard. Not deftly like Pete; that could come only with practice. The tools they used were almost fifteen feet long and made of steel bars one inch round, and there was a trick in handling them. But what he lacked in practice he was making up in energy, with Pete indicating the proper way.

Papa's boy—workin'! A heavy voice jeered behind his back, and Sam Thurber whirled about. "Td he thinks up somethin' new to do!"

It was Slug Williams, the heater, a brawny, ham-handed hulk of a man who was lounging on the bench beneath his blackboard with one of his helpers beside him. Sam recognized the situation he feared more than the slipping of an ingot or the terrors of hell fires beyond control. Slug Williams had come from the open hearth, fired by Jock Campbell because he preferred loafing and talking to second helping, and Sam had taken him on because he knew a little something about steel. He had developed into a first-class heater, too. His blackboard was always an up-to-the-minute record of what was in his pits and when it had been charged, he knew without being told just how to treat each heat of ingots that was scheduled. If they were soft steel, newly cast at the open hearth, stick 'em in a hot furnace and let 'em freeze through quick, if they were high carbon give 'em a slow heat so that the solidification of the ingot would not set up disastrous internal strains if they were cold ingots from the bank charge 'em in a cool furnace and bring 'em

up slow. All the wrinkles were his, and Slim Jackson, the screw-down man in charge of the bloomer, swore by him and his works because never once had he had to send an ingot back for reheating. But he was a sneerer, one of those men who hated all J. Orcutt Dustins, and in a flash Sam was standing over him with fury in his eyes.

"Yes, he's workin'," he growled. "With his hands an' I ain't ever seen you do anything but wear out the seat o' your pants! An' he'll keep on workin' or he'll quit—whatever he wants to do, without anything out o' you; got me?"

Slug Williams shifted on his bench and looked away across the curved roofs of his soaking-pits. "Aw, what's—"

"You heard me," barked Sam. "Keep your hands to yourself or—"

A SL LKY grumble from Slug, who could have picked up his boss and tossed him into a pit if he had been so inclined, and Sam made the threat clear.

"What's it goin' to be—keep your job, or start the bully stuff?"

Four shrill toots cut across the clamor that filled the building—a call for Sam, from the whistle of Slim Jackson. Sam was wanted in the pulpit behind the bloomer—and reminded of the errand he had set out to do before interruption by a collision. But he ignored it for the moment, as he did the scraping of feet on the gritty floor behind him, and waited for Slug to take his choice.

Then an unmistakable voice broke the silence that gripped them. "I'm looking for the coke breeze," it drawled. "Do you know where it is?"

J. Orcutt, and Sam postponed an issue and faced around. It doesn't take long, a cinder cleaning job, especially when you have joined in after it has been started, but it can make a black ruin of anyone. Under different circumstances Sam might have had a good laugh at what a few minutes can do, but it was no time for laughter then, instead he acted the superintendent.

"Slug Williams here is your boss—was his belated introduction. "Slug, this is—" he stopped, uncertain as to how to name the Old Man's son.

"Jim is my name," the blackened, (Continued on page 158)

Jim jumped up like a cat, prepared for the next move. He stood over Slug's still form, panting: "Come on, get up!"





How would you feel and act if every time you set foot out of doors, you faced a battery of cameramen like that? It's a price men must pay for being famous.

Camera Reveals Surprising Facts About Great Men

New Tests Show How to Have Your Picture Taken—Kinks for Camouflaging Big Feet or Shortening a Long Nose

By CARL HELM

HEWON'T get my vote; I don't like his looks." How many times in the last few months, have you heard that snarl of one or the other of the candidates for the Presidency of the United States?

These are days, thanks to the motion picture, radio, and the news photographer, when we don't have to go to see or hear Presidential candidates. They come to us. From afar, we not only hear their voices, but we see their faces, study their changing expressions, note their actions and demeanor, even their little eccentricities. As a result, the idea has grown up that character and ability may be judged by photographs, that the camera is at once an exact measure of the greatness of famous men and the acid test of their relations with the public. Almost any photographer will tell you that he can read the inner lives of the great and the near-great from their appearance before the camera.

Is this idea correct?

Not long ago two psychologists of Wesleyan University, Dr. Carney Landis and L. W. Phelps, undertook by scientific tests to



Franklin and Ford posing for the camera. Ford observed no tricks, but the shot caught on.



Cornered on deck. But John D. Rockefeller Jr. just smiles, as usual when the photographers ask him to "Hold it, please!"

determine just how much a man can be judged by his photographs. From a large university class which graduated twenty-five years ago, they selected the twenty most successful lawyers, doctors, teachers, engineers, and business men, also the twenty least successful. Then they obtained photographs of all forty men at graduation, and of the same men twenty-five years later. The photographs were shown to a group of psychology students, who were asked to tell from the pictures which were the successful men, and what calling each had followed.

The result was almost complete disagreement in every case. A highly successful engineer, for instance, was taken for an unsuccessful preacher; a school teacher for a prosperous banker. The only conclusion the experimenters could draw was that photographs reveal neither a man's real character nor his ability. That a photograph included with an application for a job, for example, will give an employer no accurate idea of the applicant's fitness.

ONE reason for this, perhaps, is that the ordeal of facing a camera very often definitely alters a man's customary behavior, at least temporarily, and so makes him appear to be what he is not.



As unimpaired as President Alfred E. Smith has grown serious before the camera. But having a picture taken never worries him.

Let's look at the Presidential candidates as they face the camera's eye. Herbert Hoover is the despair of the Washington photographers. Though noted for his versatility, he has just one pose for the camera—looking straight at it with an almost expressionless face. Hence his photographs are almost identical. He seldom displays more than the faintest suggestion of a smile when he poses for the cameraman. He dislikes to be photographed in full profile.

IN CONTRAST, Alfred E. Smith is the least concerned about having his picture taken. He has been in the public eye too long to let the cameras disturb him. Coming up through the political ranks, "Al" Smith always had a wide smile, almost a grin, when photographers came. But when he began being talked of for President, the Governor became more sedate and serious. He is willing to be photographed in any position but the profile. His favorite pose is full face. He prefers to be "shot" while he is talking, to be shown "doing something besides having a picture taken."

Suppose that every time you set foot out of doors a horde of men were waiting to take your picture. To the average man a visit to the photographer is as painful as a session with the dentist. You can imagine, then, the state of your nerves if you had to face a camera every day in the week.

"Look this way, please!"
"Take off your hat!"
"Now, give us a smile!"
"Hold it, please!"

This is part of the price great men pay for being famous, and it is enough to shatter the disposition and poise even of men with iron nerve. Not long ago the headlines reported of Colonel Lindbergh that he was "nervous and needed a rest." No little part of this "nervousness," his friends say, was caused by the camera. He hates to be photo-

graphed. He would rather fly through six snowstorms, they will tell you, than face a battery of photographers.

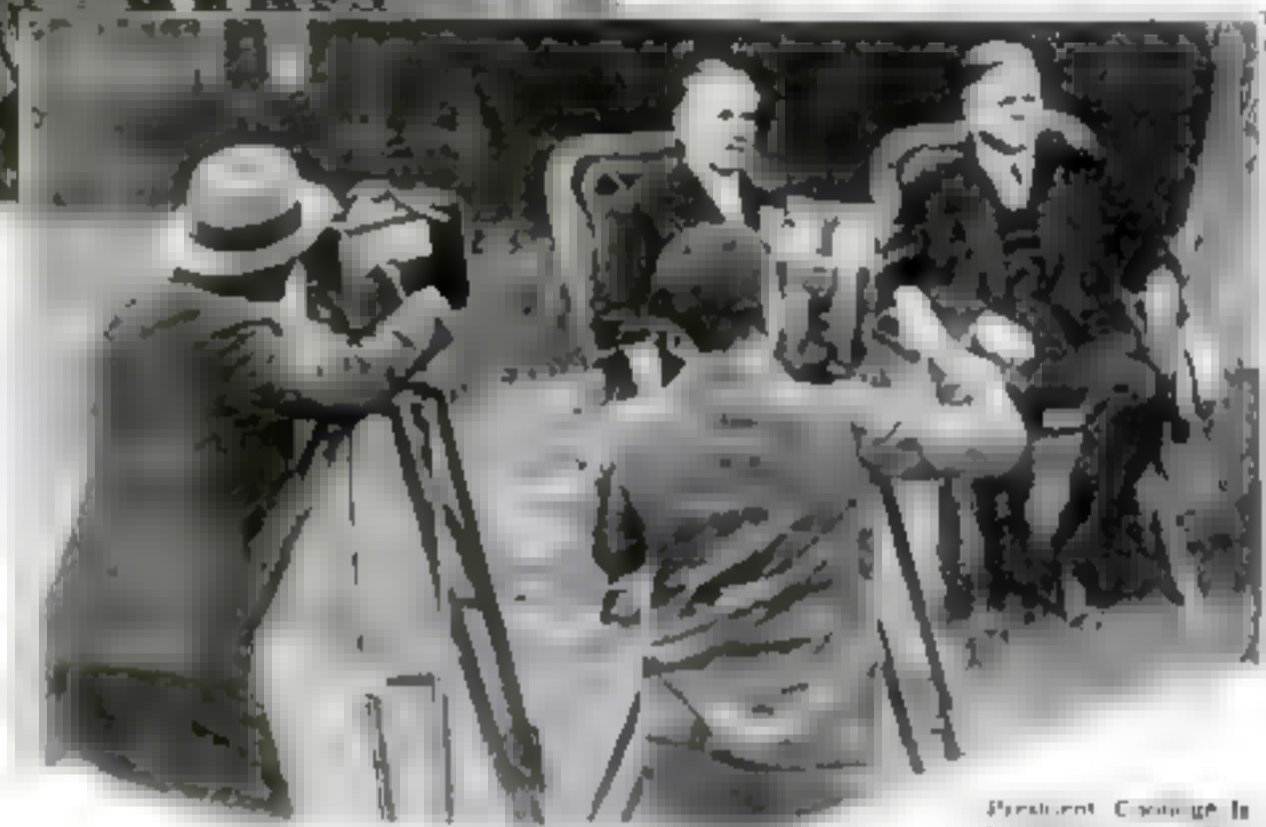
The best photographs of "Lindy" were those snapped at the flying field in Paris just after he landed in his epochal



Ever see a photograph of Sir Thomas Lipton without a merry snicker? The famous yachtsman may possibly be grouchy at times, but the camera never fails.

flight. They caught him in a rare, smiling and unselfconscious. But when he got back to New York and photographers began hovering over him, the smile left his face. It was only a natural embarrassment, but it changed him almost overnight from a carefree youth to a staid and formal celebrity. He began setting his face a sterner line. Compare those first photos of the boyish Captain Lindbergh with those of the Colonel Lindbergh of today!

The most photographed man in the United States probably is Mayor James J. Walker, of New York. He enjoys being photographed—perhaps he is the only celebrity who does. His every movement, the photographers say, is an unstudied pose in itself. And he's always smiling.



President Coolidge is a "snapper" and his is the favorite pose for the camera.

He has one little eccentricity—he doesn't like to be photographed bare-headed. His hair is sparse.

Edward, Prince of Wales, holds the doubtful honor of being the most photographed man in the world. He is the only member of royalty, too, who is consistently photographed while falling off a horse! He is self-conscious when he sits down to a posed, formal photograph. But like Mayor Walker, he takes a lively interest in the proceedings when a crowd of American news photographers surround him, and is smilingly gay about it. On his last visit to the United States one photographer shouted, "Hey, Prince! Take off your cap!" The Prince complied, laughing. "I don't like that cap myself," he shouted back. "Go on and shoot!"

KING ALBERT, of Belgium, is the easiest photographed of royalty. He sits for his picture as if he were enjoying himself. The credit goes to his gracious Queen, Elizabeth, herself a camera enthusiast. She has coached him in the trick of being at his ease before the camera, and has put her preachings into practice by taking innumerable pictures of him with her own little kodak. (Continued on page 188)

The familiar electrically-controlled semaphore block signal, which is used on most railroads. It is now being replaced by light signal systems.

Safer Signals for Railways

New Lamps That Flash Warnings in Daytime as Well as at Night Replacing Semaphores

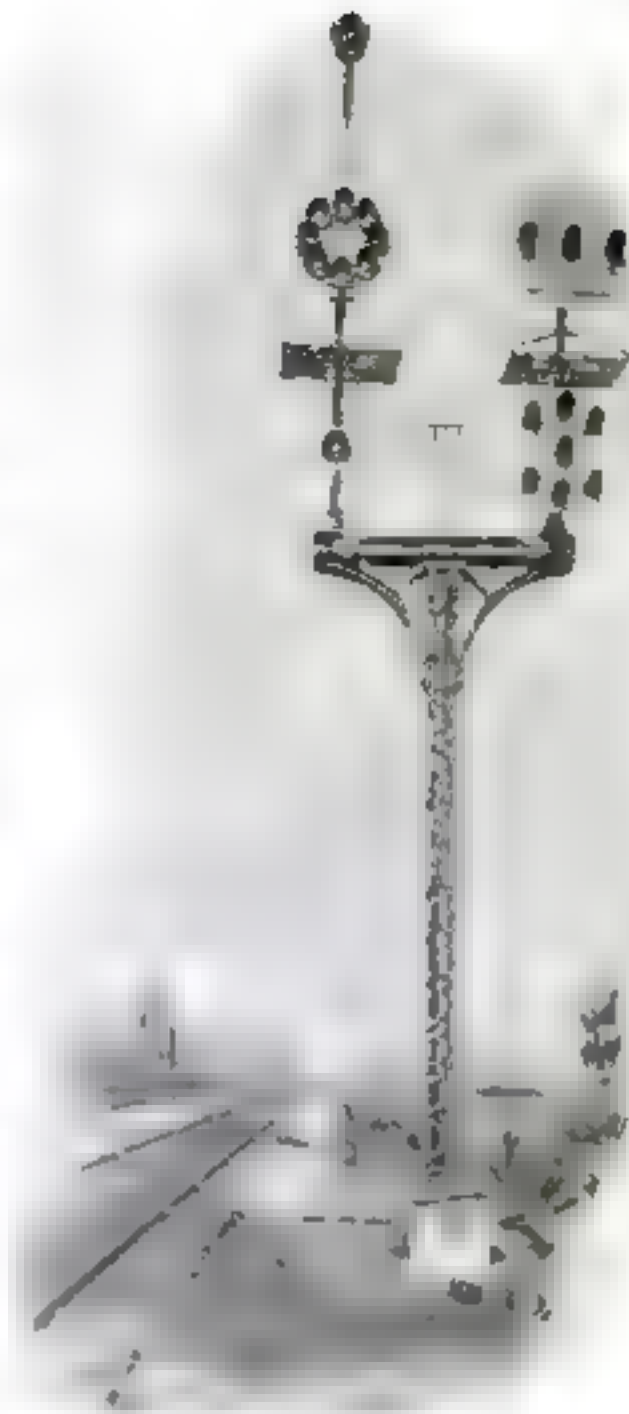
By CHARLES ADLER

ing. They represent the latest step in the safe control and dispatch of trains by visible indicators.

When hand operated semaphore signals with painted, moving arms, mounted upon a tower, were introduced in 1841, they were regarded as a tremendous step forward for safety. But they were unavailing to control the fast through trains of today, where a signal operator's failure might cause a frightful wreck. Automatic block signals, now used on all but a few local and suburban lines, removed the menace of the careless signalman, and made the signal system practically infallible. But can the engineer of a train see the signal?

Strong colored electric lights with powerful reflectors, tried out on several roads, have proved to be visible by day and night, and dispense entirely with the moving semaphore arm.

Meanwhile the Pennsylvania Railroad has devised another ingenious substitute for moving semaphores. Rows of powerful amber lights arranged on a black circular background replace the swinging arm, and may be flashed on in different groups, giving this type its name of "position-light" signal. Three lamps in a horizontal row mean "danger" when illuminated, corresponding to the "danger" position of the older semaphore. Lighting three lamps in a vertical row signals "clear," and a slanting row of lamps designates caution. Another diagonal row of lamps opposite to the last gives a fourth signal not possible with the semaphore arm. It is called a "permissive" signal, and allows an engineer to enter a block knowing a train is ahead, and is frequently used when a relief locomotive arrives to couple to the rear of a standing train.



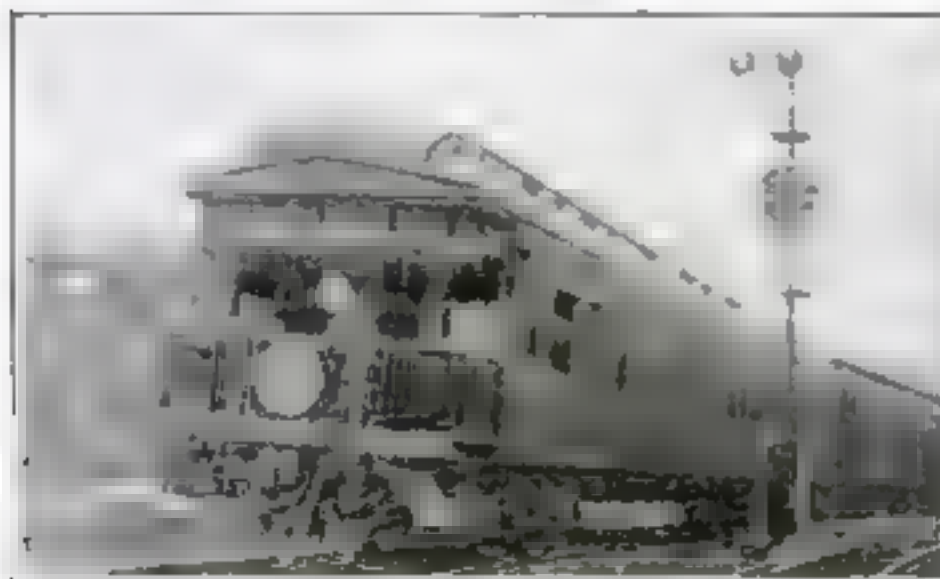
This signal, combining both the position and colored light systems, cannot be misread.

A FAIRYLAND of blinking color flashes—that is the fifty-mile stretch of track between Attica Junction and Deshler, Ohio, where the Baltimore and Ohio Railroad has just installed the latest in railway signal systems. Vertical bands of green light speed fast expresses on their way, blinking lines of amber counsel caution, and red crossbars halt puffing locals.

These new "color-position-light" signals, electric-lighted warnings visible in brightest sunshine and darkest night, are intended to remove forever the possibility that an engineer may mistake their mean-

ing. They represent the latest step in the safe control and dispatch of trains by visible indicators.

In the latest type of signal as used by the Baltimore and Ohio Railroad, colored lamps and the position-light are combined to supplement each other and make the signal unmisinterpretable. Two brilliant red lamps side by side warn of danger ahead. Green lights, one over the other, tell of a clear track; but if the lights are amber, and in a slanting row, the signal is for caution. Clear white lights in the opposite slanting position give the "permissive" signal.



The color as well as the position of these lights on the Baltimore and Ohio Railroad tell the engineer whether or not the track ahead is clear.



The position of three amber lights in vertical, horizontal or slanting rows conveys a message to engineers on the Pennsylvania Railroad.

Odd Equipment of Byrd's Men

A House with Food Walls; Mountains of "Smokes," and a City Lot of Gum, Go on South Pole Voyage

By EDWIN W. TEALE

Commander Byrd with a group of his aides, showing the dress they will wear in their Antarctic explorations.



Byrd's supply ship *City of New York* setting sail for the two-year voyage to the Antarctic. From a painting by Charles Rosner.

WHEN Commander Byrd's flagship, the bark *City of New York*, with its gleaming white hull and orange masts and cut of New York harbor recently for a two-year visit to the Antarctic it carried the first consignment of the most expensive and complete equipment ever provided for a voyage of exploration. The *Eleanor* towing, second ship, took aboard the rest. It includes the latest inventions of science, devices to produce artificial sunshine, and even an electric ice-making machine.

The bill for dog biscuits alone, nearly \$8,000, was greater than the cost of discovering America. Forty tons of them were taken to feed Byrd's 100 sled dogs. The value of all supplies and equipment for the expedition is close to a million dollars.

On the lonely wastes of the Antarctic a little village of some eighty inhabitants will be set up, with houses laid out on a street, gasoline engines supplying electricity for lights, and with a public library of 2,000 volumes.

The half-dozen houses are being transported in sections. They are specially designed for warmth in a land where six degrees below zero is common. Each of their

toy windows has three panes of glass with an insulating air space between, and there are two doors for every entrance, working like canal locks so one cannot be opened until the other is closed. The main

walls are formed of a number of thick-nesses of wood with air space between and special insulating layers of kapok, a fiber one seventh the weight of cork, obtained from pods of the tropical *Cesha* tree.

When these houses are set up at the expedition's main base, they will be sunk ten feet into the ice. As further protection against gales that sometimes attain a velocity of two miles a minute, heavy straps over the roof will anchor them. In winter, deep snow banks will give added shelter. The men will communicate between buildings through tunnels in the ice.

Another building—it's like a fairy tale—will be a house of food in which the men will devour the walls, starting from the inside and eating out!

THE explanation is this. All the canned goods have been packed neatly in small boxes devised to be opened from the side by snapping wires that bend it and opening a flap. All the boxes are the same size. When the expedition reaches its base in the Antarctic, planks, laid on the ice, will form the foundation upon which brick walls will rise, each "brick" being a box of canned food. The storeroom, thus formed, will be large enough to shelter one of Byrd's airplanes.

The flaps all will face inward so the contents of the boxes will be consumed gradually. Wooden posts in the box corners will hold them rigid after the



Byrd will use this remarkable sextant camera to locate the South Pole. Photographing the sun, it records, by the sun's position, the exact location of operator when he snaps the shutter.

cans have been removed. By piling snow against the outside, the empty boxes are expected to form a wall rigid enough to support heavy tarpaulin forming the roof.

The fact that the food must pass through extremes of temperature presented special problems in packing. Before it reaches the Antarctic it must encounter the heat of the equator; hence the electric ice machine. All tin cans are coated with a special paint developed to resist rust in extremes of temperature. Maroon was the color chosen because against it the slightest scratch that may invite rust shows up and can be given a daub of paint.

THE mountain of food, taken to support about eighty men for two years in the Antarctic, includes twenty-eight tons of meat, twelve tons of potatoes, seventeen tons of flour, half a ton of apple sauce. The onions taken by the explorers weigh 1,070 pounds more than Lindbergh's famous monoplane *The Spirit of St. Louis*. Twelve hundred and fifty cases of cheese also are making the trip. Dried fruit and vegetables total nine tons; jam, jelly, and marmalade, another ton. The morning cup of coffee will be provided from a 4,500-pound supply. It will be flavored with milk from a two-ton supply.

Three tons of beans will help make the walls of the storehouse, besides a ton and a half of kippered herring, 400 pounds of mince meat, 100 gallons of honey, more than two tons of cereals, and 1,000 packages of gelatine. Nearly 1,200 pounds of cookies will help top off the meals. For seasoning, there are a ton of salt more than sixty pounds of pepper, and 175 pounds of assorted spices.

A ton of tobacco goes along to provide relief from the strain of the long winter. With it were shipped eighty-four new pipes. And 500,000 cigarettes. Piled on top of each other, the cartons containing this mountain of "smokes" would reach up to the tenth story of an average office building.

IF CHEWING gum were used to pave the ground about their camp, Byrd's party would have enough along to cover a city lot; their supply includes 70,000 sticks. This in addition to two and a half tons of candy!

After Byrd and his men return, it should be easy for later explorers to tell where they have been by a litter of used razor blades. Sixty razors and 1,200 packets of blades went with them. Nor did



Above: L. V. Berkner, chief radio operator trying out the City of New York steam-mill. Left: Byrd inspecting electric refrigerator which will preserve food on the trip.



Commander Byrd forget his toothbrush and thirty dozen more for his men. He took along enough soap to give the entire standing army of the United States a thorough scrubbing.

The party will not lack for amusement. There are thirty radio receiving sets—from small three-tube portables to eight-tube super-heterodynes. And when reception is poor in the Ant-

arctic, the men still have three camp phonographs with a collection of more than a hundred records. The musically inclined also may strum their own banjos and ukuleles, or play a small piano included in the equipment. Besides the library of books, there is a movie projector and a film library of fifty reels for impromptu picture shows.

THOUGH powerful radio transmitters—twenty of them—should keep the explorers in touch with home, Commander Byrd has taken along 60,000 sheets of writing paper.

If anyone gets sick, the medicine kit, weighing more than a ton, contains among other things, a gallon and a half of cod liver oil and twenty-five pounds

of epsom salts. Thirty assorted varieties of illnesses are guarded against by a supply of 50,000 tablets. Lest tetanus, diphtheria, pneumonia or scarlet fever invade the camp, 300 packages of antitoxin for these maladies went into the outfit. No one's health should suffer for lack of sunlight during the long Polar night, for a huge ultra-violet ray machine will bathe ten men

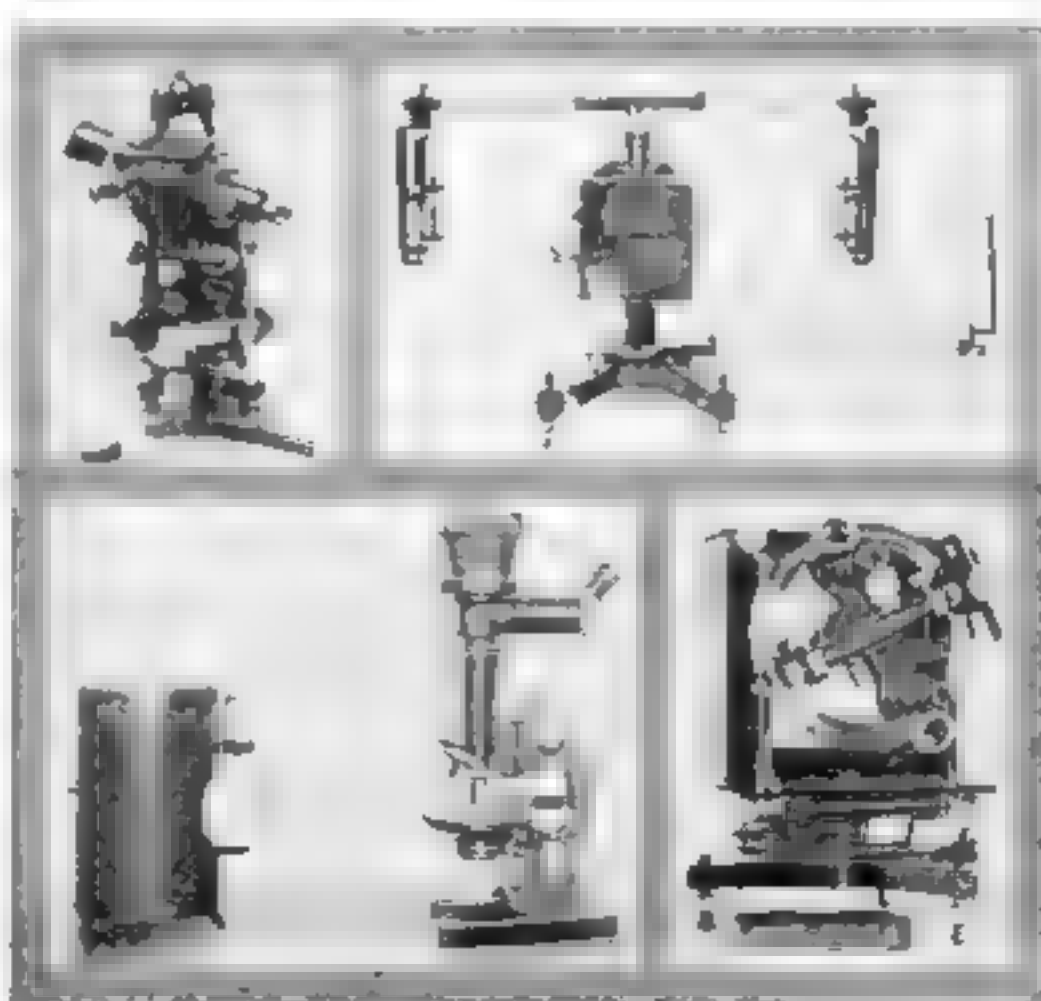
at once in artificial sunshine.

When Byrd and his men leave their village on exploring trips toward the Pole, they will draw upon still other equipment. Tents of arctic cloth are dyed burnt orange, for warmth and visibility. A new type of portable gasoline stove will cook a meal for six men in an hour, providing water for cooking simply by melting chunks of ice. Of course, the equipment includes spare parts for the airplanes that will play an important part in exploration.

EVERY man has a camera and films. In addition an automatic mapping camera will chart unknown areas from the air. One remarkable camera, a photographic sextant, will record the exact location of the operator when he snaps the shutter, by the sun's position. It will be used to locate the South Pole.

Two motion picture photographers in the party are prepared with twenty-eight miles of movie film—enough to keep a camera clicking for thirty hours.

(Continued on page 130)



Scientific instruments of the expedition. Top, left to right: Theodolite for astronomical observations; variometer for measuring earth's magnetic variations. Bottom, left to right: Photomicroscope to picture organic life in Antarctic waters; dip circle, an instrument for measuring earth's magnetic field at the South Pole.

Latest Gifts of Research

Aluminum Plating at Last

"BILLIONS of dollars" is the value placed upon the recent discovery, at the University of Illinois, of a method of coating metals with aluminum by electroplating. As announced by Prof. D. B. Keyes, of the university faculty, it solves a problem which has baffled experimenters for years—ever since the electrochemical process of extracting aluminum was discovered, back in 1883.

So many are the uses to which aluminum has been applied in industry, that it has come to be known as "the modern metal." Aluminum pots and pans that refuse to rust are indispensable to every up-to-date housewife. Every engineer recognizes the importance of lightweight aluminum parts in automobiles and airplane engines and so on.

Yet, pure aluminum lacks strength and toughness. It dents and picks easily. This weakness has limited its usefulness, especially in mechanical construction.

But now, with aluminum plating made practicable, steel or tough aluminum alloys can be given a coat of the corrosion-resisting metal.

"Pure aluminum will withstand the corrosive action of most concentrated acids and all common sulphur compounds," explains Prof. Keyes. "These agents cost industry today billions of dollars due to their intense corrosive action."

Raindrops from Smoke

DUST of the air—even coal smoke—eventually may come into wide practical use in scientific rain making.

Such was the recent assertion of Prof. C. F. Knipp, a chemist of the University of Illinois, who demonstrated how, with the aid of dust, experimenters now can make rain fall in the laboratory. A vessel is filled with air moistened to the saturation point. When this air is expanded, the moisture turns to fog. Then dust is introduced by lighting a match and allowing the smoke to filter into the vessel. Instantly the fog turns to raindrops.

While the process is in the experimental stage, "eventually it may be done in the open," said Prof. Knipp. "If the air over New York City were at the saturation point, and we wanted rain, all we would have to do would be to blow some of the city smoke into the air and we would have rain."

Women Win Clothing Test

WHICH wear more sensible clothes, men or women?

An answer to the old disputed question at last has been supplied by scientific laboratory experiment.

And it is all in favor of the women.

The scientist who tackled this ticklish

test is the noted German hygienist, Dr. Ernst Friedberger. He found the answer by placing thermometers and other precision instruments beneath the clothing of both men and women, and so measured the temperature and humidity next to their skins. In addition, he measured the amount of health-giving ultra-violet light which penetrated their garments, by means of sensitized paper inserted beneath their underthings.

He found that the temperature next to a woman's skin is as much as ten degrees lower than next to a man's, and that the humidity is from a third to a half less.

"The average modern man," he con-

cludes, "spends most of his life, winter and summer, in the debilitating climate of the tropics. Only his face and hands are allowed to stick out into healthier surroundings. The average woman, on the other hand, lives in a climate like the cool, dry air of the Alps."

Atom Thickness Measured!

FILMS of metal so thin that they are utterly invisible to the human eye have not only been produced, but also measured, in the Bell Telephone Laboratories at New York City. In recent experiments under the direction of H. E. Ives, to improve the design of photoelectric cells for television, layers of a light-sensitive metal known as rubidium, of various thickness, were deposited inside of glass tubes. When best results were obtained with one particular film, the task remained to measure it.

Ordinary methods were out of the question, for the metal particles were beyond the range of the most powerful microscopes. An entirely new method was devised. Polarized light, which is ordinary light shot through a grating that changes a "round" beam into a flat one like tooth paste issuing from a tube, is twisted by passing through the metal rubidium, and the amount of twist depends upon the metal's thickness. By using polarized light, the experimenters found the thickness of their best metal film to be just one atom, or about 1,500,000,000 of an inch.

Finds Earth Cooling

THE earth is cooling off, according to the theory recently advanced by Dr. William Bowie, Chief of the Division of Geology, U. S. Coast and Geodetic Survey.

Millions of years from now, he believes, our world will be a lifeless frozen ball.

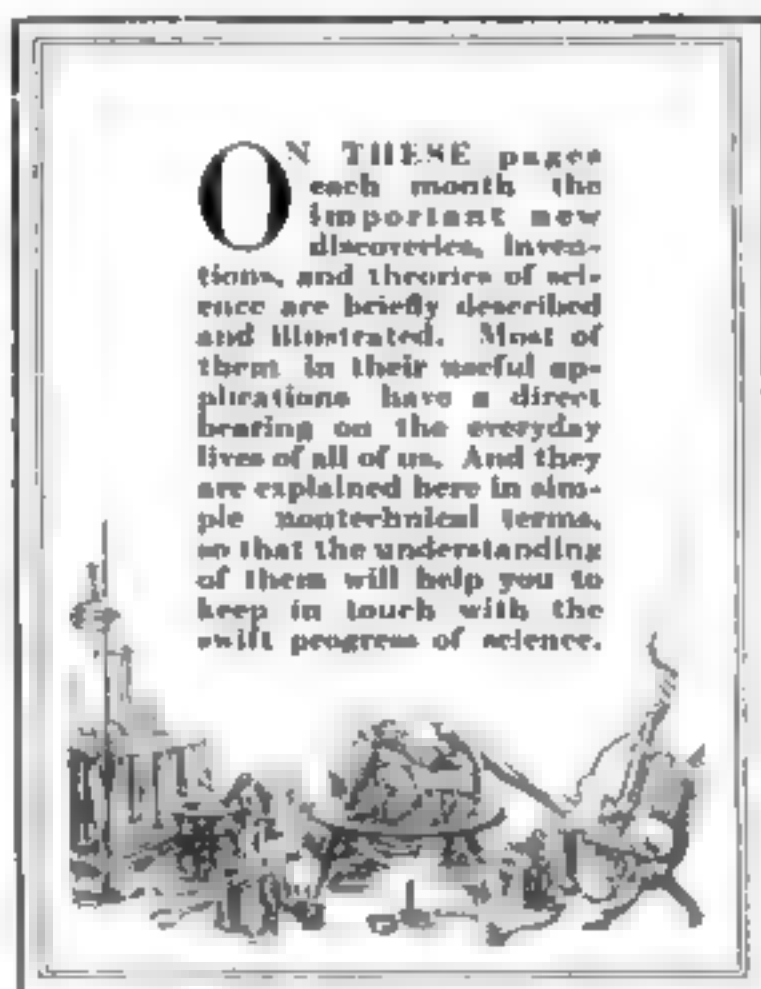
A billion and a half years ago, he says, the earth's temperature was just below the boiling point of water, 212 degrees F. Today the average is about fifty degrees F. Thus he estimates that the earth is cooling at the rate of about two degrees F every 16,000,000 years.

Summers on the American continent, as in other temperate zones, "are going to be imperceptibly cooler as the years go by."

Developing Powdered Milk

MILK bottles soon may disappear, along with bottling machines and the daily rounds of milk wagons.

According to Prof. Victor E. LaMer, of Columbia University, chemists are at work to produce milk in powdered form to simplify the problem and save costs of distribution. And Dr. H. E. Barnard, consulting chemist of Indianapolis, Ind., states that powdered milk already is being marketed in limited quantities.



ON THESE pages each month the important new discoveries, inventions, and theories of science are briefly described and illustrated. Most of them in their useful applications have a direct bearing on the everyday lives of all of us. And they are explained here in simple nontechnical terms, so that the understanding of them will help you to keep in touch with the swift progress of science.

cludes, "spends most of his life, winter and summer, in the debilitating climate of the tropics. Only his face and hands are allowed to stick out into healthier surroundings. The average woman, on the other hand, lives in a climate like the cool, dry air of the Alps."

The Healthiest Age Found

FOR more than two years, 8,000 men, women, and children of Hagerstown, Md., have been the subjects of the first study of its kind in the world, an investigation by the U. S. Public Health Service to learn new facts about the relation of age to physical fitness.

The records, just made public, reveal that the healthiest time of life is between the ages of twenty and twenty-five years. The most illness comes in early childhood, with old age next. More than half the illnesses at all ages, it was found, were respiratory ailments, chief among which was the common cold.

Sickness costs the average person in the United States \$31.08 a year, or \$134.68

Fireproof Paper Invented—X-Rays Find Flaws In Trees—Useful New Laboratory Discoveries

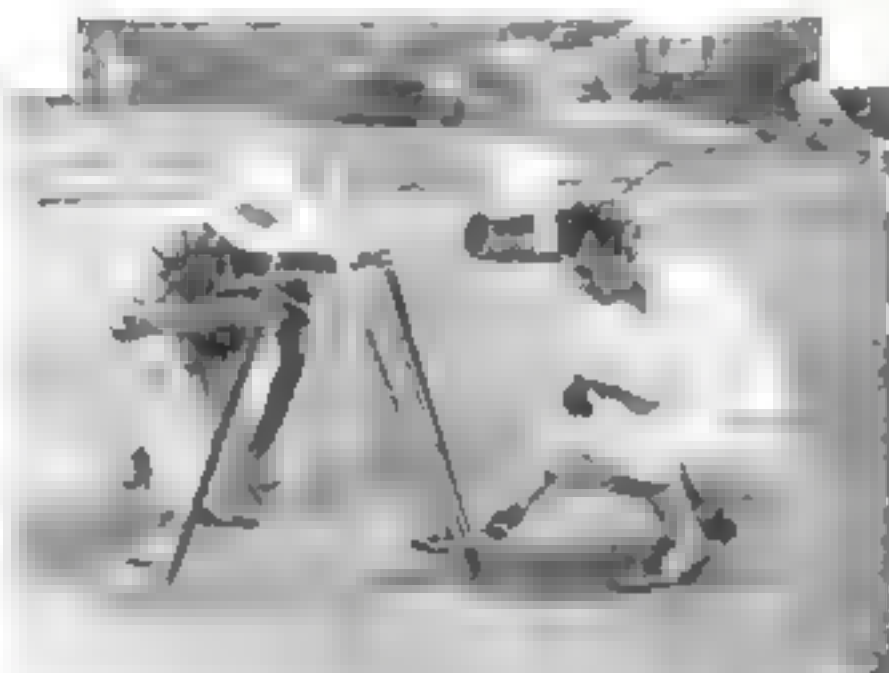
The latest use for the X-ray is to peer into the heart of a tree. With the new apparatus shown at the right, perfected by the Eastman Kodak Company, experts determine the extent of injury caused by boring insects and damage done by lightning bolts. The apparatus has a camera and a glass plate which can be placed in any position.



Put to work in studying the new disease of the cotton-wood rabbit, Dr. Robert Pearson of the U. S. Fish and Game Service has been awarded the gold medal of the American Medical Association. Here he is in his new laboratory with his chief助手.



Dr. Pearson and his assistant, Dr. Pearson, are shown in the laboratory. The apparatus is a new type of X-ray apparatus, which is used for examining trees. The apparatus is a new type of X-ray apparatus, which is used for examining trees. The apparatus is a new type of X-ray apparatus, which is used for examining trees.



Before putting greens for golfers in the air, it is necessary to examine them by experts at the U. S. Department of Agriculture. In the photograph, Dr. John M. Smith is shown. To test various kinds of greens, they use this mechanical outfit, consisting of a platform, a scale, and a platform, which is used for testing the greens. The photograph shows the result of the test.



The accuracy with which a novel of a newly designed volume can be tested in a wind tunnel, depends on the accuracy of the measurements. The photograph shows the apparatus used for testing the volume. The apparatus is a new type of X-ray apparatus, which is used for examining trees. The apparatus is a new type of X-ray apparatus, which is used for examining trees.



That twentysixth of automobile headlights are too bright is the finding of Dr. H. C. Dickinson of the U. S. Bureau of Standards. With a small photometer, which is attached to his car, he measures the glare of all headlights encountered during a recent journey across the continent.

Trapped 350 Feet Underground

Miners Buried Alive Deep in Poisonous Tomb Saved by Uncle Sam's Trained Rescue Crews—How New Inventions Help to Safeguard the Lives of a Million Workers

By BOYDEN SPARKES

Death may strike from above. Rock-falls from mine roofs account for half the underground deaths of industrial America. An explosion at any instant may rob them of every breath of air and shatter

their bones, so that they drop in their tracks like creatures in a slaughter pen. Sometimes they stumble into unseen pits and fall in blackness farther than if they had stumbled from the ledge of the Woolworth tower. But over all there is one dominating horror.

Miners call it "afterdamp."

It is a deadly, invisible, odorless gas that can kill a man in a matter of minutes. Most modern mines now have a patrol of gas detectors that give a warning as soon as the gas is detected. A diver breathes air pumped from the surface through a hose; the mine rescue crews with him a two-hour supply of breath.

With the mine rescue service that first responded to a big explosion in response to alarms of mine disasters. Within a surprisingly short time after the first word of the Mather mine explosion reached the surface, rescue cars were long behind and engines arrived on the scene. Mather nestles on a Pennsylvania hillside. It is one of the cleanest mining towns in the

AMERICAN breakfast tables were saddened one morning recently by news of four mine disasters. A total of 228 lives had been snuffed out in four days as an incident of the extraction of fuel and metal vital to the operation of our complex system of civilization.

Far underground in a coal mine at Mather, Pennsylvania, an explosion had transformed the families of 195 miners into widows and orphans; another explosion in the depths of a coal mine at Bluefields, West Virginia, had killed seventeen men; seven others had died horribly in a mine at Harlan, Kentucky; and four men had been crushed beneath tons of rock and ore in a cave-in deep in a shaft sunk into copper deposits at Knudsen, Nevada.

APPALLING as were these disasters, they were only a small part of a greater tragedy. That tragedy is the loss of more than 2,500 lives in the American mines each year; but even that fearful total would be many times greater were it not for one life-saving agency of our Government of which most Americans are little aware—the mine Rescue Service of the U. S. Bureau of Mines.

Just the other day, hundreds of trained men from mines in all parts of the country assembled at Butte, Mont., to demonstrate their skill in saving unfortunate comrades entombed hundreds of feet beneath the earth's surface. The event was the International First Aid and Mine Rescue Contest, staged annually under Government auspices. There first aid teams displayed the scientific practices of treating injured victims. There, too, mine rescue teams, wearing gas masks and oxygen breathing apparatus, vied with one another in solving problems which might be encountered in the event of disastrous mine explosions or fires.

Living entombment is one of the most dreaded fates. And every one of a million American miners is always shadowed by the chance of being buried alive. But that is not their only danger.



Then he was found by the rescue crew, equipped with scientific apparatus.

Right: The rescue crew found the body of a miner who had been trapped for days.



IN A glass case at the American Museum of Natural History lies the naturally mummified body of an Iowa copper miner, entombed by a cave-in centuries ago. The figure testifies to the hazards miners always have faced. But it also is a reminder of the service of modern science in saving lives underground.

Mr. Sparkes tells here of this heroic rescue service, and of how the annual death rate in American mines has been reduced, from one in every 200 men employed, to three in a thousand.

United States. Normally about 750 men work there in eight-hour shifts. In the course of a year they bring to the surface nearly a million tons of high grade coking coal.

The night shift was just going into the workings in the huge elevator cage of the main shaft, and the day shift men were leaving, when the explosion came. Nick Shraake lived to tell how

A. G. P. 111
U. S. Bureau of Mines

it felt to him. There was a dinner bucket on his arm as Nick stepped from the cage into the wide corridor of the main entry, 850 feet below the surface. He had advanced only a few steps when he felt a rush of air against his face. A moment later a blast of air knocked him down, as it knocked down hundreds of others. Many of them never got up. A coal mine explosion drives through the black passageways with something like the force of a charge of powder in a cannon.

"AFTER I was knocked down," recalled Nick later, "I struggled to my feet. Then hot, black smoke hit my throat and lungs. I was dizzy, and wandered the wrong way—away from the shaft. At every step I stumbled over rocks, coal and timbers hurled down from the roof. At last I realized I was going the wrong way. It was hard to breathe. I went back, falling at every other step. I heard men shouting and knew I must be near the air shaft that led to safety. Then the gas must have

depths. Their first job was to consult mine officials, read maps, ask questions. How many men were entombed? Where? Was the mine on fire? They must be prepared for all emergencies.

Car Number 3 is one of the crack rescue cars of the Bureau of Mines. It was put into commission only recently. Already it has seen valiant service. Grim adventures are the common lot of men who bunk in this rolling laboratory.

Everything in that car represents the last word in scientific mine rescue apparatus. Beneath the car are stored stretchers, oxygen cylinders, coils of rope suitable for Alpine climbers, and sheets of canvas designed to serve as emergency

human lungs. A rescuer who carries one of the birds into a mine knows that when the bird succumbs it is time to go—also that he still has time to go. Other equipment in the car includes a dozen sets of oxygen breathing apparatus, as many gas masks, two dozen carbon monoxide self-rescuers, two dozen electric flashlights, ten electric cap lamps, and chemical apparatus designed to warn of afterdamp by means of changing colors.

THE principal types of rescue apparatus necessarily include tanks of oxygen. The same air is breathed over and over, but each lungful passes through a filter of caustic soda contained in a bag slung from the wearer's back, and the oxygen supply comes steadily from two small tanks, also strapped to his back. If he has a two-hour supply of oxygen, then he has a two-hour lease on life.

IN THE Government apparatus the rate of oxygen supply is controlled automatically by the wearer's breathing. He breathes into and from a small bellows. When the bellows is sucked flat a valve opens allowing oxygen to feed in rapidly from the compression tank through a reducing valve. Thus, the supply adjusts itself to his needs during rest, when the consumption is only 300 or 400 cubic centimeters per minute, and during vigorous exertion, when it is between 2,000 and 3,000

cubic centimeters per minute. Each wearer wears goggles to shield his eyes from smoke, a clip tightly closing his nostrils, and with the mouthpiece of his breathing apparatus held "air-tight" within his mouth, man after man of the mine rescue services of state and nation went down the deadly shaft of the Mather mine. These men found and sent to the surface the limp bodies of scores of miners. A few living men they carried out, but most of these were rescuers who had collapsed under strain. Nowhere in the mine was there breathable air. The only men who escaped were men near the air shaft when the explosion came. Some of these had carried Nick Shraake to safety. A few had rushed down a stairway from one level of the mine to a level where they heard cries for help.

Ordinarily the doors of such stairways in mine workings are air-tight and carefully guarded. Mine workers, knowing their only hope is to keep themselves supplied with air, hold each passageway as a unit. Fans at the surface, when all is going well, keep air flowing into the deepest of the tunnels. The men who rushed down that crude stairway knew they were abandoning safety for peril. They went bravely into the blackness of the debris-strewn tunnel. Great chunks of fallen coal and heavy timbers pinned one worker to the tracks. (Continued on page 164)



Rescuers exploring a mine. Center man is using a device to detect gas.



Pungent smoke and poisonous gas in the new entry of a mine after an explosion.

got me. I fell. The next thing I knew was when I came to, at the surface."

Meanwhile, word of the disaster had been flashed by telephone and telegraph to various mine rescue cars stationed in Pennsylvania. After a night of tragic vigil, frantic women and wide-eyed children saw a strange looking railway car shunted on a siding nearest the pit mouth of the Mather mine. Lettered on its side was this legend:

"United States Bureau of Mines
Rescue Car No. 3"

But the Bureau of Mines rescuers did not at once don their breathing apparatus, rush from the car, and plunge into the

walls or "brattices" in mine tunnels.

In the car itself are kitchen, dining room, an electrical refrigeration system, berths for the crew, a complete electric light generating system, a schoolroom where miners learn how to wear oxygen breathing apparatus; and in addition a curious store of apparatus designed to cope with flame, fume, and gas.

CANARIES sing in that surprising vehicle. They are the most elemental of mine life-saving appliances. Long ago men discovered that when canaries fall from their perches because of foul atmosphere it is time to find better air for



Here is a small Spanish house of simple, attractive design built in Sacramento Calif. at a cost of only \$5,800. By its genius arrangement of rooms, almost every foot of the floor space is utilized to advantage.

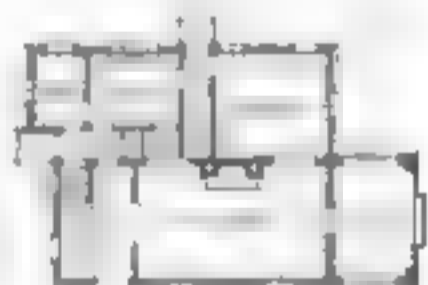
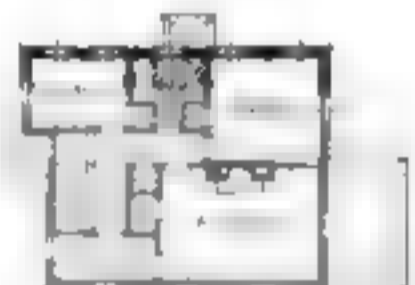
Improved Homes at Modest Cost

THE attractive dwellings pictured on this page are typical representatives of the latest advances in design and construction. Chosen from among hundreds of houses displayed in a recent nation-wide "Better Homes in America" competition, they offer convincing proof of the fact that attractive homes, embodying every modern comfort and convenience, can be brought within reach of families of modest means. All can be built at surprisingly moderate cost—the price depending somewhat, of course, on local conditions.

Radically different types of architecture are represented here. You'll find it interesting to study the plans and to decide which you like best. And if you're planning to build, no doubt you will find ideas that will prove useful.



Another Spanish-type house, at Santa Barbara, Calif., a marvel of economy and beauty. This one cost only \$4,165. Notice the arrangement of living, dining, and bedrooms to give plenty of air and light.

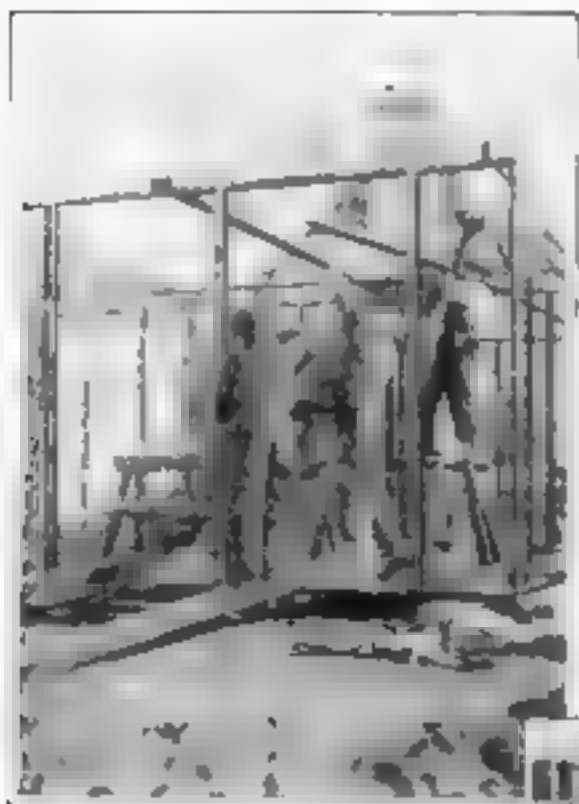


Girls of the Hutchinson High School, Buffalo, N. Y., planned this shingled house to show that unusual angles, if correctly handled, may add much to convenience in use. It cost \$6,800 to construct.



A brick home at Greenville, S. C. ideal for space economy. First and second floor plans above reveal advantages of arrangement possible in a square house. Each bedroom has cross ventilation.

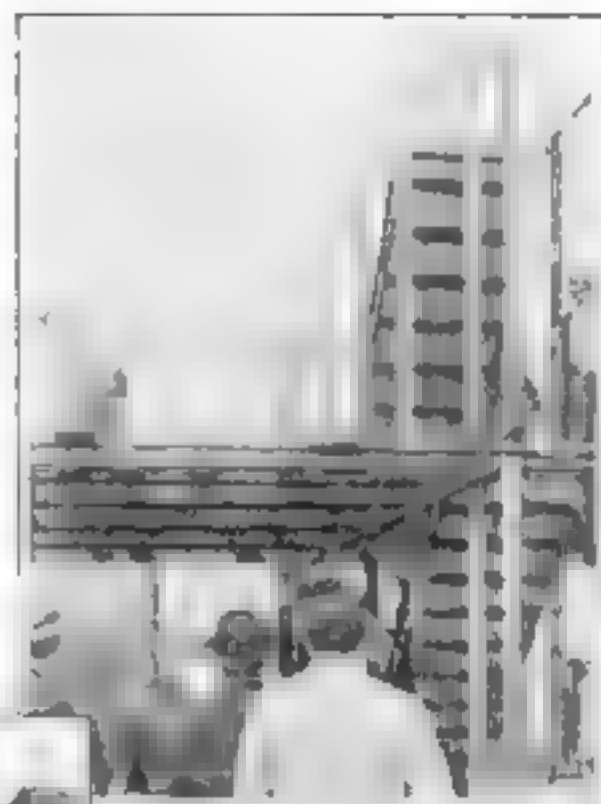
It's Here—the All-Steel House



Erection of the steel framework of a house at Forest Hills, N. Y., in three hours and fifty minutes. The side framework being raised and bolted.

Homes Already Reared in a Few Hours Point the Way to Wholesale Building by Assembly of Standard Parts—Mass Production Will Reduce Labor Costs

By
ARTHUR A. STUART



Beams and joists of the second floor are placed and firmly bolted and the steel stairway to the attic is erected. Side framework and roof are next.

IN DETROIT, where automobiles are made and assembled with the speed and economy of a magic that is purely American, a steel house took shape recently with similar speed. One hundred minutes after a small crew of erectors appeared on that Detroit site the steel frame of the house was bolted into shape, its permanent stairways were in place, and all was in readiness for the next stage of construction—the placing of the floors and roof.

Through this demonstration and some fifty others in different places in the United States, the prospect for small house building which has lagged far behind other industrial processes in America, has spurred forward amazingly. Each of these houses possesses in miniature the steel frame of a skyscraper, but they have, besides, a special significance and interest for the American family that can afford to spend around \$5,000 for a home that will last a lifetime.

My interest in this development was first caught when in Forest Hills, Long Island, near my own home, there was a similar demonstration of rapid erection of steel framework for a small house. Three hours and fifty minutes by a stop watch after the hard-muscled crew of five steel workers had donned their overalls they stood on the staunch steel roof-tree, finished, and a crowd of watchers cheered.

TIME had been the important element in the demonstration. The saving in time, and therefore of labor and other costs, is the thing that is expected to overbalance the greater cost of steel materials.

At Forest Hills and Detroit the erectors went at their work with a rush. The steel



Checking over the steel material which a few hours later was a house, built as illustrated in the photographs above. The material had all been cut by the factory to the required dimensions.

had been cut to size and shape and all bolt holes drilled. By means of spreaders and clip plates the parts were brought into line and held fast in a rigid frame.

The first step was the placing of the ground floor girders and beams, next the side framework was assembled and raised into position, then the partition frames and main stairway. Mounting that stairway, the workmen placed the second-story joists; then they raised the second-story bearing wall frames, bolted into position the stairs to the attic, and placed the attic floor beams, the roof trusses and,

finally, the roof-tree. The skeleton was finished. No derricks or hoists had been used, merely a rope tackle and from time to time a couple of wooden horses on which the workmen stood.

In these operations I see the beginning of an important movement in small house construction that has behind it all

the weight of the economic pressure that is chiefly responsible for our present-day system of mass production.

America leads the world in low cost, mass manufacturing of many useful products. Practically everything we eat, wear, or use has become a factory-made thing. Because of this we Americans are the most prosperous and comfortable race on the face of the earth. By scientific drafting the perfection of machinery is made possible and by means of machinery we have achieved mass production.

IN THE last fifty years there has occurred a revolutionary change in the production of the necessities of life. Even the poor among us have become accustomed to utensils of living that would not be within the reach of even moderately rich men except for this same principle of mass production. In only one field have we shamefully lagged behind its possibilities, and that is in the first essential of any civilization—the building of homes. We still build houses much as they were built in the middle ages.

Suppose that Henry Ford, or Nash, or Chrysler, or the General Motors people, built each car as a separate job. Suppose, after getting your order, they brought cumbersome machines, many mechanics and much more material than necessary around to your back yard and proceeded to make your automobile. Not more than one man in hundreds could afford even



The completed Forest Hills house in which the higher expense of steel framework was offset by the saving of labor in the erection.

the feeblest kind of automobile. Yet that is precisely the way we continue to build small houses, and that is why small houses are grotesquely expensive. The slowest kind of construction, the most laggardly wasteful, is that which is reserved for the people who can least afford this waste—the people of small incomes.

Before they can hope to change the character of small house building in America, steel men realize, they must change the methods of building. To that end their engineers, draughtsmen and architects are striving to evolve a plan for the swift erection of small houses, that may become an American phenomenon like the swift erection of skyscrapers.

AT THEIR last convention in Pinehurst, N. C., the American Institute of Steel Construction heard tempting things about this new market for steel. During 1928 about \$2,000,000,000 will be spent on cheap houses of a type in which seventy-five percent of the material can be standard size, and another two billion will go into other simple types of wooden structures. They were told that if all of these buildings were to be provided with steel frames, the total steel business would be increased approximately \$400,000,000. But this vision can be realized only if the steel manufacturers can offer frames on a competitive basis with wooden ones. This they hope to do by keeping their plants busy during what would normally be periods of depression, in making steel members for small houses to be stored like lumber until sold to small-house builders.

When mass production is discussed in connection with houses the objection is made that no one wants a house that resembles millions of others. But the argument is worthless, for basically a dwelling consists of rooms and their size and arrangement may be varied endlessly at the owner's wish without conflict with a scheme for mass production.

Standardization of plan is an important economical factor in production. This should be as true of houses as it is of automobiles, radios, vacuum cleaners, cameras, electric refrigerators, telephones and hundreds of other inexpensive conveniences. The easily standardized parts of a house represent probably seventy-five percent of the total cost. Individuality may be retained by



The woodless house of a Gary Indiana, steel man. Only brick, plaster, and other metal supplemented the framework and accessories, which were all of steel. Above: Putting in the steel ceiling of the living room.

complete freedom of treatment of enclosing walls, roof covering, color, location, the shape of entrances and porches, location and design of chimneys.

Everyone who might contemplate building a low price house is interested first of all in the cost. Such information as I have been able to obtain indicates that sixty percent of the cost of a \$5,000 wooden house today is spent for labor and forty percent for materials. But there is

that our civilization could not endure without it. So no one there was surprised a few months ago when the president of a steel company let it be known that he was going to build a house containing not so much as a stick of wood.

NATURALLY, for the president of a steel company the matter of expense is secondary. Nevertheless, even the erection of a mansion of steel may be expected to advance the cause of the small steel house. And the small steel house is a goal toward which steel men are striving just as did far-sighted automobile builders who saw a score of years ago that big fortunes awaited men who could produce cheap automobiles.

In this Gary steel house, advantage was taken of every existing steel appliance. After the frame had been raised, steel window sash began to arrive, followed by lath, radiator cabinets, doors, trim and bathroom cabinets. As the building took shape bricklayers veneered the hollow tile exterior and a brick chimney rose through the center of the house.

With the framework in place, steel fabric stretched across the tops of the floor joists and the

(Continued on page 14.)



This photograph shows the sturdy steel construction of the Gary house, which makes it proof not only against fire but against all but the most severe windstorms and earthquakes.

hope that by changing the character of the materials, perhaps even spending more for them, labor costs may be reduced so as to make the completed house a stronger, finer thing that has cost less than the old fashioned wooden house.

ROBERT TAPPAN, the architect of the steel frame house in Forest Hills and the one in Detroit, told me that if the materials of a \$5,000 wooden house cost \$2,000, the materials for a steel framed house like it would cost \$2,500. "But," he added, "the labor on the steel house will be \$2,500 or less as against \$3,000 on the wooden house."

In Gary, Ind., where steel has raised a city out of the flat prairie within twenty-odd years, there are men who have a positive affection for steel that holds them as other men are held by a love of horses, politics, or fine books. Most of them spend their lives within sight of the cherry-red glow of blast furnaces. They work so close to steel in the making that the terrific heat often scorches their skins. In Gary, men are more constantly aware than most of us that this is the age of steel and

Hot Water When You Want It

You Can Have It Always on Tap with Improved Automatic Heating Units That Save Countless Worries in the Home

By JOHN E. LODGE

"**M**ARY! Why in blazes isn't there any hot water this morning? You might at least wait till I get through shaving before you draw it all off!"

"It's your own fault, John. You forgot to light the heater when you got up. Now you'll just have to wait."

Conversations like this, with variations, are common in thousands of homes. Most times they concern lack of hot water, but other unpleasant happenings also start heated arguments and take the joy out of life. Such, for instance, as having nothing but scalding steam come out of the hot water pipe, bathtubs filling with rusty water, faucets springing a leak, or bursting pipes flooding the place.

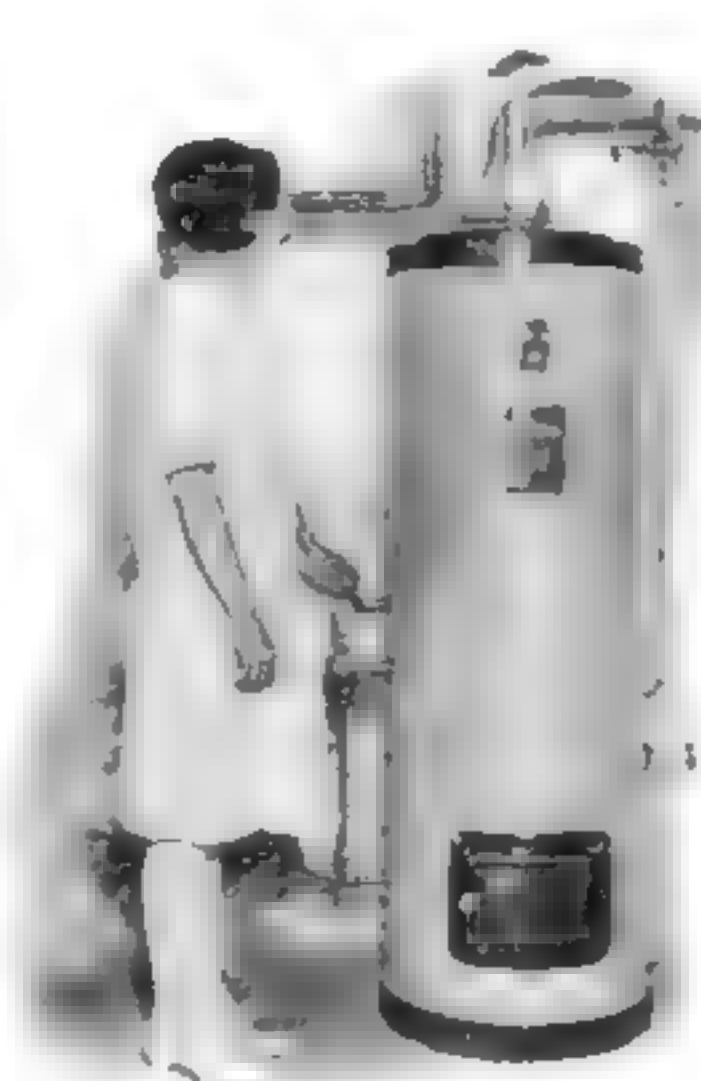
Yet none of these things need happen. With improved heating systems now available, hot water always is on tap, day or night, it is always clean, and hot enough without being too hot; faucets almost never leak and pipes never burst!

Many home owners do not realize how easily hot water troubles now can be banished. Of course, the solution depends on local conditions. In some places, gas, electricity, or both are not available. It also depends, as far as expense is concerned, on the type of heating plant in your house.

The ideal water heating system consists of a thermostatically controlled electric heating element and a heat-insulated storage tank. If the house is fitted with brass piping throughout, it meets every requirement. The water will always be hot enough without being too hot, and since the brass piping cannot corrode, the water always will be clean. However in most localities this system has one great drawback—the cost of electric current is so high that only the very wealthy can afford it.

FORTUNATELY, where gas is available you can have a system almost as good—the automatic gas water heater. Its only disadvantages, compared with the electric system, are that it requires a flue to carry off the products of combustion, and that if the gas pressure is shut off for any reason, the burner must be relighted by hand. A typical automatically controlled gas water-heating unit is shown at the top of this page.

If your home is brass-piped throughout, it makes no difference how high you run the temperature of the hot water. The brass pipe will last almost forever. Water at temperatures much above 150 degrees, however, is very hard on iron



One of the improved types of gas water-heating units automatically controlled. It meets all home requirements.

piping. That is one reason why many homes have so much trouble with rusty water. Extremely hot water also disintegrates the cheaper types of faucet washers, causing trouble with leaky faucets.

Of course, it costs money to heat water all the year round with gas. The gas bills for the average small family will run from seven to fifteen dollars or more a month. The natural desire, therefore, is to obtain the heat from your furnace in winter. This can be accomplished satisfactorily only with a steam heating plant. In that case you can install a small round iron tank containing a coil of copper pipe which is connected to the top and bottom of the hot water storage tank. Water from the steam boiler is piped to circulate in the

small tank, surrounding the copper coil. Since water in a steam boiler always is at or near the boiling point, the water in the storage tank is heated by flowing through the coil, until it approaches the boiler temperature. It never can quite reach that temperature, however, due to radiation losses, so there is no danger of explosion. If your piping is brass, this method, in winter, in conjunction with an automatic gas water-heater in summer, represents maximum luxury at the lowest possible cost. Iron piping, however, is likely to deteriorate under the frequent high temperatures.

THE water-jacketed coil cannot be used with a hot water heating system, because during mild weather the temperature in the boiler goes too low.

Where gas is not available, the best system is the thermostatically controlled coal-fired water heater. A sectional view of a unit of this type is shown at the bottom of this page. The thermostat opens and closes the draft so that the fire is automatically regulated. This heater will give as much hot water as the automatic gas heater at about half the cost, assuming average prices for coal and gas.

Other methods of heating water are in widespread use, but they have many disadvantages. There is, for instance, the hand controlled gas heater consisting of a coil of copper pipe over a gas burner. It will give plenty of hot water but turning it on and off is a nuisance, and if you should forget to turn it off, there is possibility of a serious explosion.

THESE simple and relatively unsatisfactory gas heaters often are installed with a pipe extending into the fire box of the furnace, to get hot water in winter without using the gas. Of all methods this one is the most unsatisfactory. If the pipe or cast-iron spider is placed too low in the fire box it interferes with the fire and supplies too much hot water. When a hot fire is going you may have to drain off the water every few hours to prevent an explosion. And if the pipe or spider is placed higher, you get no hot water during mild spells, and yet there still is danger of explosion when you speed up the fire during a cold snap.

THERMOSTAT
OPENS OR
SHUTS DRAFT
ACCORDING
TO WATER
TEMPERATURE

How coal heater is controlled by thermostat. It needs attention once a day.





Subduing a \$2,000,000 fire on the Hudson River waterfront at Jersey City. Two fire boats, *New York* and *New Jersey* are seen pouring streams on a blazing pier.

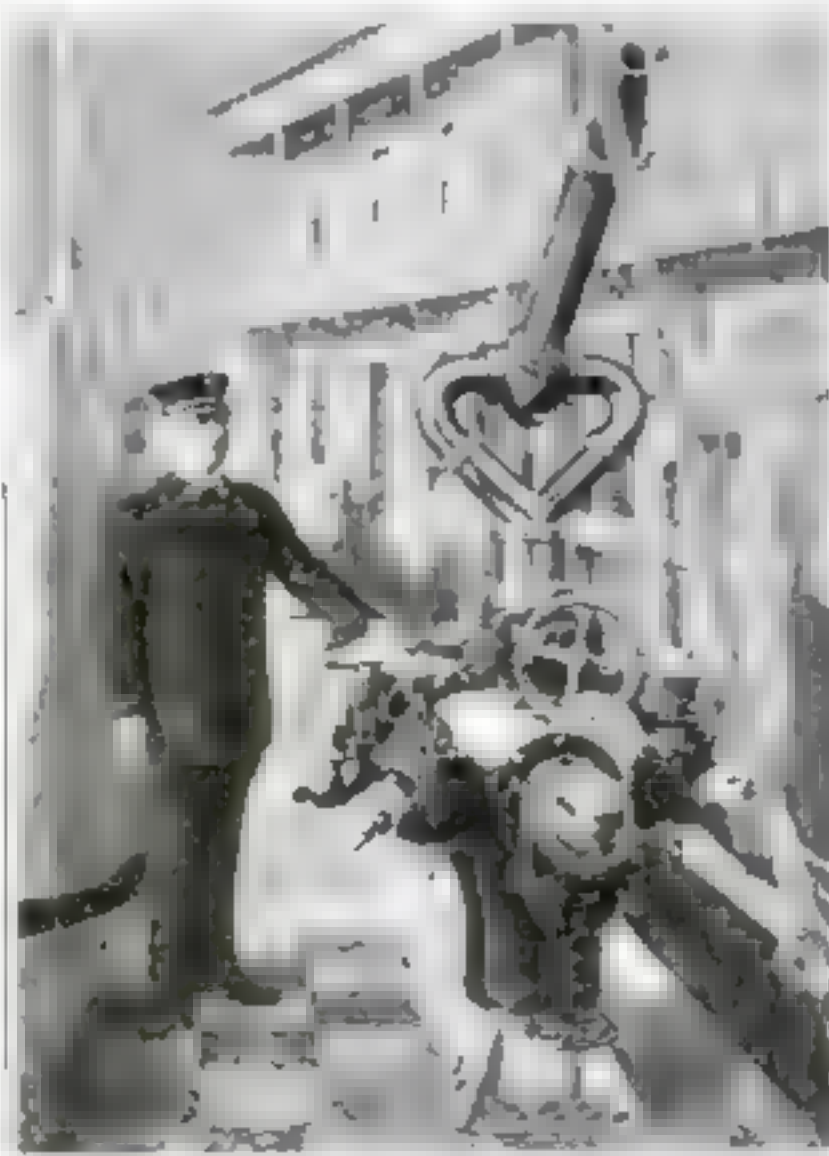
John Kenlon—Fire Fighter

How Modern Science Tames Smoke and Flames Is Revealed in the Amazing Experiences of New York City's Fearless Chief

MAROONED! First Officer John Kenlon clung to a barren ledge of Hog Island, 1,800 miles west of the coast of Australia, and watched the last splintered planks of his vessel sink beneath the waves. Thirty-six hours ago he had been treading the bridge of a crack clipper ship bound from Liverpool to Melbourne. For the past day and night he had hung on to a bucking wheel while a savage hurricane had blown his ship 500 miles off her course, finally crashing her upon the cleaver rocks of Hog Island, an extinct volcano jutting out of the sea. The keel had been sheared off like cheese, and of the graceful hull not one whole plank remained. And now, the nineteen survivors of that crash were marooned in the loneliest part of the South Atlantic, castaways all, without food or shelter—300 miles off the nearest shipping lane!

As if this situation were not desperate enough, the captain now sickened and died. First Officer John Kenlon succeeded to the command—and a forlorn command it was, too. The men were utterly demoralized, starving, and shelterless. Straightway the new captain, scarcely more than a boy, began building up the morale of his crew. He organized hunting and fishing details, planned rude grass huts for

By
HENRY MORTON ROBINSON



Kenlon twenty years ago, as chief of the Marine Division of the New York Fire Department, on the deck of a fire boat.

shelter, and devised a huge fire beacon which was kept burning day and night. To keep his crew occupied while they waited for a passing sail he contrived to interest them in games and exploring expeditions. When one of the sailors broke an arm, it was Jack Kenlon who bound it in a rude splint of driftwood. As surgeon, captain, and his own chief-of-staff, the young leader kept a cheerful grin playing over his ruddy Irish countenance. But as he strode the bleak cliffs with his closest companion, Tom Fleming, he was despondent over the chances of getting his men off the desolate island.

"If only I could invent some kind of a craft," he kept saying to himself. "But what is there to invent with?"

"Nothing! No tools, no timber—nothing but sand and rocks and sea!"

"**WELL,**" he said to the faithful Fleming, after two months of fruitless waiting and exploring, "about the only thing left is to lie down and dream out a way to escape the fix we're in."

"Dream?" queried Fleming in surprise. "You never struck me as being a dreamer, Captain. I've always thought your ideas ran to something more practical and concrete."

Concrete . . . a spark struck Jack Kenlon's inventive brain, setting it on fire with a daring idea.

"That's it, Tommy lad," he cried, scrambling to his feet. "Concrete . . . We'll build a concrete boat!"

"A concrete boat?" gasped Tom. "Why, Skipper, a concrete boat would sink."

"If an iron ship floats, why not a concrete ship? It's only a question of displacement. Anyway, it's worth trying. There's some limestone in these cliffs, we can crush and burn it for cement. As for sand and stone—there's no lack of either on this island, I'm thinking."

So Skipper Kenlon set his men to crushing rock, while he himself built a kiln in which to burn limestone for cement. He had built dozens of concrete houses with his father in his native Irish village, and had a thorough knowledge of the art. After three weeks of careful testing and mixing, he decided that he had the best concrete that could be made. At this point he turned his attention to the framework of the boat. With a few sticks of wood salvaged from the wreck of the clipper ship, he laid the skeleton of a boat thirty-two feet long and with a beam of eight and a half feet. To reinforce the slender strakes of his craft, ropes were laid along the core of the keel, with ribs of rope lying transversely across it to strengthen the sides of the boat. The actual pouring of the concrete was done in forty-eight hours. When the last scoopful had been poured, the weary company scarcely dared breathe the question uppermost in every mind:

It'll she float?

THAT question was definitely answered when the concrete sloop made its trial trip around the island. With Kenlon at the tiller and Fleming in the bow as lookout, the boat attained a speed of ten knots, answered the helm beautifully, and shipped not a drop of water. The crew danced wildly on the beach as they watched the first vessel of its kind ever made by man skim the pounding breakers. They wanted to set sail at once for Australia, but the young captain would not be hurried into this long voyage without careful preparation. He made the crew salt down a month's supply of fish and rabbits, while he put the new boat through a series of grueling trials. Triumphantly, she met them all! Finally, after a four months' sojourn on Hog Island, Captain Jack and his crew boarded their strange craft, and shoved off for the open sea.

In ten days they covered 1,600 miles without sighting a sail. Kenlon had no sextant or compass, but by dead reckoning laid a course for the west coast of Australia. When they were within 200 miles of their destination, with the concrete boat still staunch and seaworthy, they were picked up by a Melbourne merchantman. Their rescues were unable to take the concrete sloop along, so it was regretfully abandoned.

THUS without loss of life or limb, Jack Kenlon brought his crew to safety in a homemade boat of sand and stone. Incidentally, the principle of its construction was so sound scientifically that the United States made hundreds of them during the World War.

As John Kenlon sits in Fire Head-



The Grand Street fire of May, 1924, described by Kenlon as the "most punishing" he ever fought. Choking clouds of smoke overcame fifty firemen before the chief arrived. He conquered the menace by breaking a skylight at the top of a stairway and forcing a smoke draft upward through the building.

quarters in the New York Municipal Building, overlooking the city he has served for nearly half a century, he will tell you that he regards this and his other adventures on the high seas merely as preparatory to his life work as a fire fighter.

"The sea develops a man's combative spirit," he once told me, "and the science of fire-fighting utilizes every ounce of that spirit."

The same resourceful genius that led him to invent a concrete boat has asserted itself in a thousand ways during his upward career from a fourth grade fireman to the most famous of living fire chiefs.

The kernel of John Kenlon's attitude

towards fire-fighting is this: he regards every fire as a scientific problem, capable of the same deft and positive solution as a problem in laboratory physics.

THIS statement can be best demonstrated by a survey of half a dozen typical fires during the past thirty years in which Kenlon has played a major rôle. The first of these, and in some ways the ghastliest New York has ever seen, occurred on St. Patrick's Day in 1899, when the Windsor Hotel at the corner of Fifth Avenue and Forty-sixth Street was destroyed with a loss of fifty lives and \$1,000,000. The Windsor, although it was the most fashionable residence hotel in the city, was a veritable tinder box—



Firemen throwing water upon the Windsor Hotel fire in 1911. At that time, he was mostly sick of water pressure during the fire which he had been fighting for a day with high pressure pumps.

"It is to be hoped," as Kenlon afterwards remarked, "that no more escapes, no standpipes, no old-fashioned steamers, etc. In short, it represented the worst type of the old-style 'quick-burner'."

At 3.30 p.m., just as the St. Patrick's Day parade was passing the hotel, a Windsor servant noticed that the lace window curtains on the second floor parlor were ablaze. He started for an alarm box on Fifth Avenue but was blocked by the dense crowds watching the parade. Within five minutes red waves of flame were billowing from the second story windows, and when the fire apparatus arrived, the Windsor was blazing like an oil-soaked pitch barrel. Flame-stricken guests hurled themselves out of windows or were incinerated in the drafty corridors. Milling thousands on the Avenue obstructed the firemen after their long run uptown (at that time the bulk of the apparatus was massed in the financial district, some five miles from the scene of the fire). And to cap a fearful climax, the water supply was found to be utterly inadequate!

KENLON, at that time a lieutenant with a record for conspicuous bravery, was ordered to throw a stream into a fifth-story window to protect a hook-and-ladder rescue party. He coupled his line to the hydrant, started water, and waited for the stream to materialize. But the port-

and main pumps were taxed to their limit and sent out only a pitiful sixteen pounds of pressure at the nozzle of Kenlon's line! "You could not even wash a window with that pressure," was his bitter comment as his little stream barely lifted itself above the fire.

In the meantime, the fire was temporarily beaten.

Six hours later the Windsor was a heap of smoking ashes, crumbling in great bodies of half a dozen stories. Kenlon, who had been in the city for some time, was a New York fireman, and he was the rapidly changing archi-

gradually placing New York's fire apparatus on the junk heap! At a time when department politics made it dangerous for a young officer to speak his mind, Kenlon came out flatly for the high-pressure system, and was one of the most influential workers in the long campaign that saw the new system installed under Mayor McClellan in 1907. Thus, after ten years' struggle, Kenlon saw four thousand new hydrants in New York, with a maximum pressure of three hundred pounds at every plug!

KENLON'S grasp of the scientific principles of fire-fighting was demonstrated at the official trials of the new high-pressure system. The tests took place along the North River front, and were witnessed by officials of city and state. Mayor McClellan, much impressed by the terrific force of the water, was curious to know exactly how far the high-pressure pumps could force an effective stream.

He turned to Kenlon, standing near by. "Chief," he inquired, pointing to a twenty-story warehouse and office building, "can our new system throw a stream over that building?"

"Yes, Your Honor, it can," replied Kenlon without hesitation. "That building is only 350 feet high. With 200 pounds pressure on a two-inch line, the water will climb 150 feet over the building."

The water was started and mounted exactly 300 feet into the air!

KENLON had carefully inspected the new centrifugal pumps, located in four main pumping stations, and had worked out complete tables showing how high any given pressure would lift a known column of water. To him, Mayor McClellan's question was a simple problem in mathematics that he could apply with practical results to any building in the city. When Chief Kenlon orders a stream of water, he knows precisely where and how it will hit, and can prophesy with startling accuracy the effect it will have upon a conflagration.

"No two fires are alike, and no two fires will respond to the same treatment" is one of his favorite maxims.

Some fires need homeopathic and some need allopathic measures. One fire has to be knocked out with a single blow; another has to be wearied into surrender."

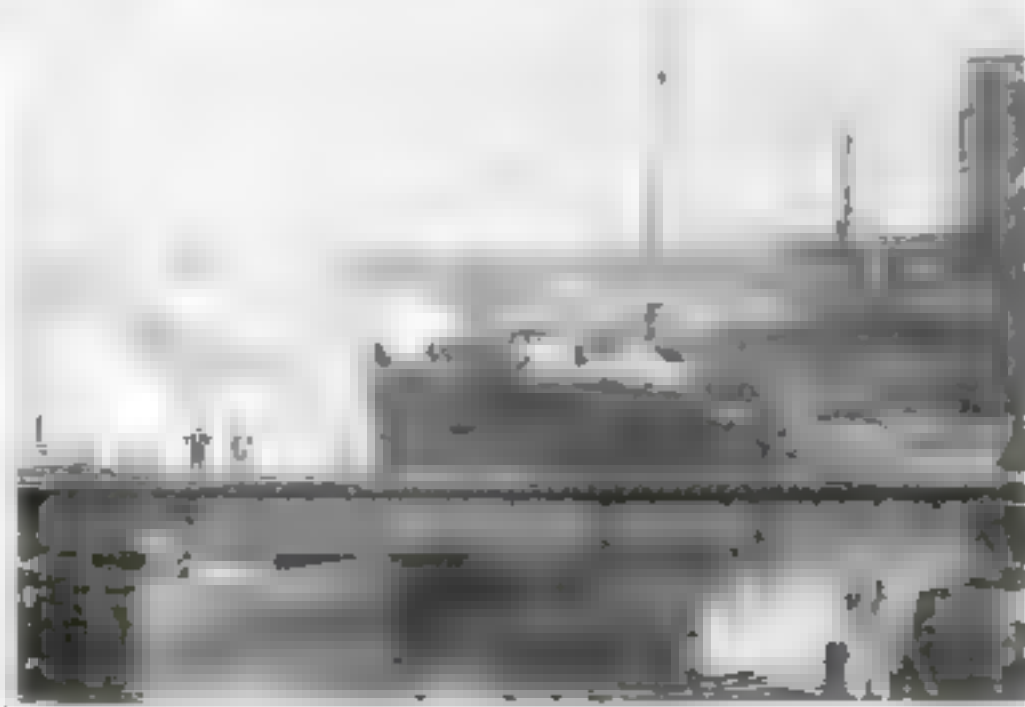
As examples of this thesis, he recalls the Williamsburg Dock fire of 1911, and the Equitable building fire of 1912.

The Williamsburg Dock fire started with an explosion in a sulphur works. Directly across the street were oil yards of the Standard Oil Company, while fifty feet away were huge hay sheds, a thousand feet in length. When Kenlon arrived upon a third alarm, the sulphur works were



To Chief Kenlon, the firemen directing this stream have a definite part to play in the solution of a scientific problem.

ture had rendered the old-style "steamer" as useless as the hand pumps which it had supplanted fifty years before. The passing of the wooden tenement and the advent of the modern, many-storied apartment house and skyscraper was



New York's 600 miles of waterfront present a fire hazard without parallel in any other city. Here is a view of a dangerous dock fire at Brooklyn, N. Y.

(Continued on page 172)

Millions for Mending Stockings

How Two Young Brothers Invented a Marvelous Machine Which Fixes the "Runs" in Women's Silk Hose

By EDWIN KETCHUM

TWO young jobbers of hosiery have just become potential millionaires.

Within the last few weeks, they have seen their invention of an amazing stocking repair machine valued at \$20,000,000. Perhaps, by the time you read this, thanks to their device, a disconsolate maiden with seemingly ruined stockings may walk to the nearest store and for a quarter or more, depending on the damage, have the pair returned to her as good as new.

That is the climax of the story of two young brothers—one twenty-five years old, the other thirty—who believe they have ended the bane of "runs" in silk stockings, after years of disheartening effort. The corporation they have just formed to exploit their remarkable invention includes the highest officials of a great New York hosiery concern. As rapidly as they can be built the machines are to be installed in retail stocking shops throughout the world.

Five years ago Samuel B. and William H. Leavin were the proprietors of an obscure New York shop where they embroidered stockings for manufacturers. William had studied art for several years, and later had joined his younger brother in the business.

ALWAYS interested in the mechanical side of their business, the brothers amused themselves by devising and trying out numerous improvements on machines in their shop. "In fact," William says, "we perfected one 'impossible' stitch that is still a mystery to the largest manufacturers."

Then came the idea of a run-mending machine. It was a logical consequence of their embroidering trade.

Stockings had to be run through the embroidering machines at high speed. Many a "second," or damaged silk stocking, resulted when one of the machines failed of perfect adjustment, or when the hand of the girl operating it caught in the silk. "Seconds" cut deeply into profits; and the brothers decided to see if they could devise a machine to mend runs.

To build models of working parts for such a machine was costly. The brothers scraped together what money they could spare and went ahead. A part was built and tested, only to be discarded. Another succeeded, and was incorporated in the final design. At last, they arrived at a



The operator needs only to sit before the machine and feed the stocking in until the "run" is mended.

final plan which they believed would be commercially practicable if they could acquire capital to build and market the device. They went to officials of a New York hosiery concern with their drawings. So impressed were the latter that they supplied \$100,000 with which to develop the device.

Now a complete model could be commenced. Almost at the start, the inventors encountered seemingly insuperable difficulties. To determine in advance the course of the broken thread, as the almost-human machine fed it back in and out along the stocking's weave, appeared an almost hopeless task. So did the problem of controlling a needle that must fly back and forth rapidly enough to make three or four thousand stitches a minute! Not until about a year ago, when a crude model worked after a fashion, were the inventors encouraged to make a fresh start and attempt the final machine.

NOT long ago they stood again before the hosiery company officials, this time with the finished model. On its polished white base it resembled a sewing machine—but a sewing machine without a thread. Its cord was plugged into a wall socket, and one of the brothers placed a badly-run silk stocking on the feeder rack. A hum as the power was turned on, and—before the officials' eyes, the run disappeared! There was the stocking as whole as when new!

Actually the machine had sewn the



The women's "Summer" brand and Wall-Less is demonstrated here how the machine not only weaves a broken thread back into the sock, it can make 250 repairs a day.

broken thread responsible for the run right back into the fabric—a feat made possible by a specially shaped needle with an eye at its tip that vibrated up and down almost faster than the eye could follow it, directing the thread up and down through the cross threads of the weave. So perfect was the control of this needle that with uncanny accuracy it always skipped over one cross thread and plunged under the next, re-creating the original weave. A pedal and a knee control were provided.

ALl that the operator had to do, the inventors explained, was to sit before the machine and feed the stocking into it until the mend was completed. It was entirely automatic. It could make 250 to 300 repairs a day.

The men who had advanced the money for development of the machine were enthusiastic, and for their company made the inventors a handsome offer—a million dollars apiece for all rights.

A staggering sum? Not to these young men, for they flatly refused it! Instead, they chose a share in the profits of their machine's operation. Their choice seems easier to understand when a person stops to think of the giant industry that is built around women's legs! Each year no less than a hundred million dozen pairs of stockings are sold. More than a third of them, or 33,000,000 dozen, are silk—fragile, and easily torn. If all the damaged stockings could be repaired, estimates place the saving to American women close to \$80,000,000!

That is why the brothers who were once humble jobbers await the fortune that may be theirs when soon their machine is placed in service all over the world.

Solving the Mystery of Twins

New Tests Reveal Astonishing Facts about Secrets of Human Life and Problems of Environment and Heredity

By E. E. FREE

WHEN Nature sets out to produce a pair of twins one of her methods is the exact reverse of the marriage service. Instead of joining two to make one, Nature divides one to make two. The chief reason why many pairs of twins are so astonishingly alike that even their own mothers sometimes get them mixed is that they are not really two individuals at all, but are two halves of one individual, split apart early in the formation of their bodies.

At a meeting of the Eugenics Research Association in New York City a few weeks ago, Dr. H. F. Perkins and Miss Laura Bliss, of the University of Vermont, reported a remarkable scientific study of fifteen pairs of twins. When the right hands of both twins of one of these pairs were placed on a measuring chart they were found to be identical in size and shape. The two left hands were also the same. But when the right hand of one twin was compared with his own left hand, differences were found. The corresponding sides of different twins were more alike than the two sides of the same twin!

Measurements were made of other parts of the body and in almost every instance the right side of one twin turned out to be a virtual duplicate of the right side of the other one, like coins struck from the same die or slices cut from the same loaf of bread, each of which resembles all its sister coins or sister slices more perfectly than its own two sides resemble each other.

Like nearly all living creatures, a human being grows from a single fertilized egg cell. This cell divides, each of the two cells thus formed then divide in their turn, and so on until the complete body is produced.

During the earliest stages of this development by division the group of cells is a tiny oval particle somewhat the shape of an egg or a lemon. This tiny group of cells con-



Moe and Sidney Becker, of New York City. Twins, as surprisingly alike, says science, are actually one person split in two.

tains all the potencies and abilities of the body that is to be formed.

For ordinary human births the group of cells merely goes on with its growth and forms a human body. But when "identical" twins are to be formed, some accident or some natural process causes this small lump of living matter to split in two, as a lemon might be split along its axis of length. Both of the split halves grow independently and develop into complete creatures. Since the corresponding sides of each are descended from precisely the same original living cells, both left sides are identical, both right sides are identical. But left and right of the same twin, being of different cell ancestry, may be unlike.

A Dutch investigator Dr. P. J. Waardenburg, discovered two years ago two pairs of twins who might seem, at first sight, not to fit this theory. Identity existed but was of opposite sides instead of corresponding ones. One fourteen-year-old girl had a gap between two of her teeth on the left side of her mouth. Her twin sister had a precisely similar gap, but on the right side. In the other pair both twins squinted, one in the right eye, the other in the left.

This can be explained, however, by the theory of one individual splitting in two. If both split halves continue their development facing the same way the right sides of the two twins will have sprung from the same cells and the final human beings will be of the completely identical type. But if one of the split halves turns around, then the left side of one twin will have the same cell ancestry as the right half of his brother and the twins will resemble each other on opposite sides. Each such twin is a reversed image of the other, like the image reflected in a mirror.

Twins of the kind studied by Dr. Perkins are more likely, of course, to look exactly alike, and it is such pairs that are responsible for the mistakes and embarrassments which often make the lives of twins so interesting. Within the last few weeks two separate pairs of twins have even dislocated the machinery of American courts.

In Columbus, Ohio, the O'Connor twins, Mark and Clark, pleaded guilty of violating the narcotic laws. Judge Benson W. Hough thought that each twin should serve ninety days in jail. But one twin had already been in jail sixty days awaiting sentence while the other had been locked up for thirty days. To even things up Judge Hough sentenced what he thought was Mark to sixty days, Clark to thirty. Then the trouble

began. Some one protested that Mark and Clark were mixed. The long and short



The Crotem family of Quebec—twenty-one children including five sets of twins; four in front row and the fifth behind Mrs. Crotem.

sentences should have been reversed. In despair of ever getting the twins properly sorted out the judge decided, newspapers reported, to let both of them go.

At about the same time, the Munroe twins, John and Alexander, went on trial in New York City for raising checks. But no one could decide which twin had actually passed the checks. Even the detective who arrested them was unable to tell them apart in court until he had them stand up. John, it seems, is slightly the taller. The court solved the problem of identity by convicting both twins and giving each the same sentence. Further confusion will be impossible, for when the finger prints and Bertillon measurements were taken after the conviction differences in the brothers were disclosed. This is always the case when this method of identification is employed, for in no instance so far discovered have the finger prints of twins proved to be exactly the same.

One of the most ancient ideas about twins is that there exists between them some unexplainable "mystic bond," so that one twin knows what the other is doing, lives the same kind of life, and dies at the same instant. Modern science admits some truth in this idea, explaining it by the fact that twins have exact similarity of brain as well as of body.



These twins, young from the same day, are the Prys boys born in Seattle, Wash.

Dr. G. P. Crowden of the famous Guy's Hospital, in London, reported not long ago the case of twin brothers twenty-five years old, born in India but educated in England. Not only did these brothers follow almost identical careers in school and in business, but they had identical habits. They demonstrated their astonishing mental likeness in still more remarkable ways.



Officers at Fort Stoom, N. Y. have contributed a full squad of twins to the personnel of the post. Which of these four sets of twins would you say are "identical" and which of them are "fraternal"?

For example, when asked independently to draw an outline map of England from memory both boys began at the same point and made identical errors. In one college examination they were accused of cheating because their papers contained identical mistakes. They were exonerated only by the fact that they had been seated too far from each other for possible communication. A still more astonishing coincidence is that when one twin was caught throwing a paper wad in school his brother on the other side of the room was detected about to do the same thing.

Direct proof of this intimate and deep-seated resemblance between the brains of identical twins turned up recently in a Philadelphia hospital. One twin died at the age of six and a half years with symptoms of a certain kind of brain tumor. The other twin died two years later with the same symptoms. Dr. F. H. Leavitt says that both twins had developed similar tumors at corresponding spots in their brains. Some minute

defect existed in one of the living cells of the original individual which split. The two individuals, both created from those same original cells, carried with them that same weakness. Both developed the equivalents of the original tumor and died.

Dr. E. P. Twining of New York City recorded nine pairs of twins whose childhood illnesses and other medical misfortunes were identical, while at a recent meeting of the American Neurological Association, in Washington, D. C., Dr. J. M. Wolfson and Dr. S. A. D. Wilson reported four pairs of twins in which each member suffered from organic nervous disease precisely like that of the fellow twin. In one pair of the four, both twins also developed diabetes at the same age and both died, also precisely at the same age, from a burst blood vessel at the same spot in the brain.

These bodily misfortunes do not always happen so exactly at the same age. But one thing that science can say to every identical twin is beware of misfortune, mental or physical, which have already befallen your brother. They are likely to happen to you also. It is equally true, of course, that things in which your twin brother—or sister—has succeeded will be successful for you.

One of the most convincing proofs that identical twins are single individuals split in two was reported recently by Dr. H. C. Craven Veitch, of London, England. Two baby boys each displayed the very rare human condition of six toes on each foot and six fingers on each hand. Occasional deformities of this kind are known to run in families and to be inheritable. Undoubtedly they correspond to some slight malformation of the original living cells from which the body grows. In Dr. Veitch's case the splitting of these cells must have passed on to each twin this same inherited defect.

Study of twins separated in infancy promises an answer to one of the greatest present problems of science—whether heredity or environment most affects the shaping of human character. Two such twins were born in St. Vincent's Hospital, in New York City, in 1901, and named Eleanor and Georgiana Kelly. Georgiana was adopted by a South Bend, Indiana, family when only eighteen months old. Six months later (Continued on page 148)



In ten years the Rogers family of Omaha, Neb. had four sets of twins, claimed as a record for America.

Latest Ideas for Radio Beginners

Voltage Control Simplified

New Safeguards for Electric Sets — Testing Loudspeaker Quality — Uses for Old Parts — Hints for Drilling Panels

SEVERAL devices have appeared on the market that will prove useful if your electric receiver is located where the voltage of the line current is too high. One of them is shown in the illustration on this page. It is plugged into the electric light socket, and the plug from the electric set is screwed into the socket provided. A knurled rim can be turned to move a pointer that indicates figures on the barrel of the device. A concealed resistance is thus adjusted to cut down the effective line voltage.

Devices of this type, of course, are not automatic and consequently they will not take care of fluctuations in the line current. All that such a hand-adjusted device can do is to cut the average voltage down to a point where the high peaks still will be within safe limits.

Comparing Loudspeakers

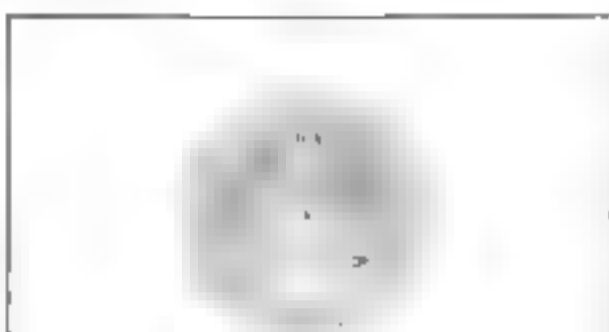
HUMAN ears are such tricky pieces of mechanism that they can fool you into believing something that actually is not so. That is why it is so hard to judge loudspeakers. After hearing a loudspeaker in a friend's home, you may decide that it is not as good as yours when you turn on your own radio receiver a half hour later. Yet your friend's speaker actually may be much better. You probably have listened to your own speaker until your ear has become trained to overlook its deficiencies. Then, when you hear a superior speaker, your ear actually resents the presence in the music of tones and overtones that you ordinarily miss.

That is why it is almost impossible to compare two speakers unless you can hear them alternately working on the same receiver, with some arrangement that will permit you to shift instantly from one to the other and back again. By shifting back and forth quickly enough to catch part of the note on one speaker and the remainder of it on the other, you can get some idea of their comparative ability to reproduce high notes and low

How Panels Are Ruined

THERE are two ways to ruin a radio panel during the drilling operations. One is to let the drill slip and scratch an ugly gash across the panel that will prove an eyesore all the time the set is in use, and the other is to drill the holes in the wrong places.

Of course the way to avoid scratching the panel is to take



A B C's of Radio

THE resistance of any copper wire depends on its length and diameter. The shorter it is and the larger in diameter, the lower the resistance. Whenever you force electric current through the resistance of a wire you use up voltage or pressure. Thus, in figuring the wiring for any electrical circuit you must consider the amount of current you must force through the wire, and the voltage available to do the job.

The A-circuits of a modern electric set, for example, operate at voltages from $1\frac{1}{2}$ to 3, with the current running from 1 to 2 amperes. With such heavy current at low voltage, heavy wire must be used. On the B-circuits, however, the current runs in small fractions of an ampere and the voltage may be as high as several hundred. Here even very small wire will serve. The resulting small drop in voltage will be unimportant.

your time and be very careful. An extra half hour spent on the job certainly is worth while if it results in a perfect job.

Curiously enough, in most cases where the panel is ruined by misplaced holes, the fault is due to gross errors in measuring rather than to slight inaccuracies in

marking the point where the hole is to be drilled.

For instance, you may have the panel on the bench ready to drill and your mind may be filled with a firm determination to make a perfect job. You are extra careful in the handling of the ruler and the rest of the tools so as not to mar the finish. With these precautions thoroughly in mind you read a figure from the blueprint that calls for a hole three inches above the baseboard. You absent-mindedly place your ruler on the panel and with extreme care mark off three inches from the bottom of the panel, completely forgetting that the baseboard is a half inch thick, so that the actual measurement from the bottom of the panel should have been three and a half inches. Result: A ruined panel or a useless hole that spoils its appearance. Sometimes it is possible to hide a small hole by filling it with black sealing wax.

Uses for Old Radio Parts

THE fact that radio parts ordinarily do not wear out brings up the problem of what to do with old-style variable condensers, sockets, audio transformers, tuning coils, cumbersome old dials, and so on. If you have been a radio experimenter for some time your workbench undoubtedly is cluttered with parts that are just as good as they ever were. Yet you don't wish to put them in a new set for your own use.

However, if you will check up your list of acquaintances you probably will recall one or two older people in straitened circumstances who would appreciate a radio receiver of almost any kind. They, at least, will not be fussy about the fine points of modern radio apparatus. Get the old parts together and see if you can't, with the addition, perhaps, of a shiny new panel, put together a set that will give one of these friends a lot of pleasure.

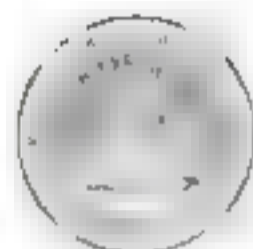
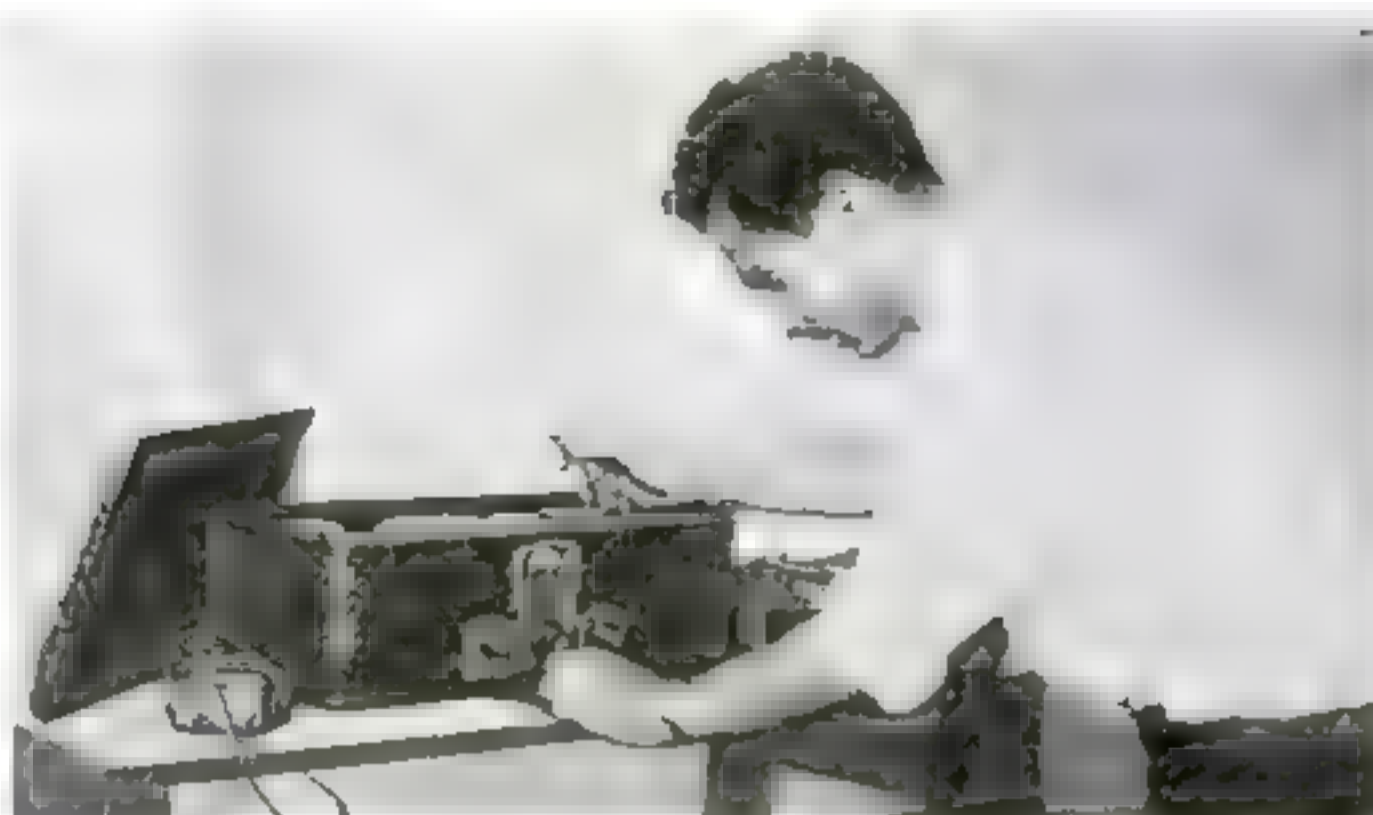
Solder with Rosin

RADIO receivers do not become less efficient as they grow old unless soldering paste has been used as a flux in making the soldered joints in the wiring. Such paste in time will creep over the insulated surfaces and cause an actual loss in signal strength. It is true that solder flows a bit easier with common soldering paste, but rosin core solder makes just as good a joint and the rosin itself is a good insulator.



One of the new resistance controls for cutting down line voltages that are too high. It plugs into the electric light socket, and in turn receives the plug from the electric radio outfit.

When power line voltages fluctuate seriously, the best thing to do is to call a service man to test the variations and adjust your receiver for the best average tone and volume.



How to Keep Your Electric Set in Working Order

By JOHN CARR

ELECTRIC radio receivers of the modern type cause less trouble than older battery operated sets. Occasionally, however, something does go wrong. Chances are that even if you are familiar with the battery operated receiver, you will hesitate to fix the electric set. Full electric operation somehow seems more mysterious. Actually it is not.

When a battery set goes dead, the trouble, in most cases, is failure of batteries. Power failure in an electric set means simply that the electric light current has been shut off.

The electric set, however, is subject to one trouble that never bothers a battery set. That is power line voltage fluctuation. The extent of this depends on the current requirements of your locality and the arrangement of the power lines. If, for instance, you are located at the end of a branch line some distance from the pole transformer, you are likely to notice a drop in voltage, causing lower volume in the evening when everybody turns on the lights. From ten to eleven o'clock the voltage will start to rise again as people go to bed.

If the fluctuations are severe, you are likely to have trouble with burned-out tubes. The first thing to do is to have a service man test the line voltage fluctuations over a period of twenty-four hours. He can then adjust your receiver for the best average results.

The only way you can make such a test yourself is with a high grade voltmeter of suitable range. Judging the voltage by the apparent heat of the tube

filaments or the brightness of the dial light is inaccurate and useless.

Another possible trouble is a breakdown in the power unit, which stops reception. In every electric set is an alternating current transformer with a primary winding connected by a cord and plug to the house current supply. This transformer has several secondary windings. Usually there are two or more of low voltage to supply filament current to the various types of tubes in the set, and at least one winding that steps the current up to a voltage two or three times higher than that of the house current. A short circuit in the primary or low-voltage secondary windings is rare, so that if anything goes wrong with the transformer it is most likely to be a short circuit in the high-voltage winding.

When this happens the set stops operating, although the tubes still may glow dimly. There is a smell of burning insulation and wisps of smoke sometimes come out of the compartment containing the offending transformer. The only cure is a new transformer.

A TROUBLE with somewhat similar symptoms is a blown filter condenser. One of the sections in the group of high-voltage condensers may give way and become short-circuited. If the current is left turned on, the extra load on the transformer will rapidly heat it to the point where the characteristic smell of burnt insulation is produced. Here again, the only cure is the substitution of a whole new condenser block.

Actual breakdown of the mechanism of

an electric set, however, is uncommon. Usually when trouble comes the tubes are to blame. Four types of tubes are in common use in electric sets. A rectifier tube in the power supply circuit rectifies the alternating current for the B-circuits. As this tube nears the end of its life it passes less and less current. The B-voltages consequently drop with corresponding loss in volume. Just before the tube goes dead it may cause peculiar gurgling and quavering noises.

IN THE radio-frequency and first audio amplifier stages the low-voltage A C tube is used. If one of these tubes goes bad in a radio-frequency stage, the result will be a loss of signal strength. Tone quality will not be affected. If the tube in the first audio stage gives out, the set will seem to be as sensitive as ever, but the tone will become thin and scratchy with considerable distortion.

The heater-type tube operating on two and one fourth to two and one half volts of alternating current is universally used in the detector stage. It is this tube which is responsible for the time which elapses between the turning on of the current and the reception of signals. This time interval may vary from fifteen to forty-five seconds or more. The signals always come in more quickly with a new tube than they do with an old one, and this fact can be used as a rough indication of the condition of the tube.

A common battery type 171A power tube, or two of them, in a push pull circuit is the regular last stage of audio amplification.

A Modern Set in Easy Steps

You Begin Here by Building a One-Tube Outfit, and Add to It Later, Until You Have a Full Electric Receiver

By ALFRED P. LANE

HERE is the first of a series of radio constructional articles that will appeal particularly to beginners. Each one will describe a complete receiver starting with the inexpensive, modern one-tube receiver detailed on these pages. The next and succeeding articles each will detail the same receiver with additional parts to make it more powerful, so that the last article will describe a full electric set that will give good results on distant stations, show a satisfactory degree of sensitivity, and operate a loud speaker with good tone and volume.

As you will note from the front view of the panel, the receiver, even in the one-tube stage, looks complete, and the panel appearance will not change materially as the additional apparatus is added. The baseboard, which shows clearly in Fig. 3, seems somewhat underused. Succeeding articles will show how this space is utilized in enlarging the set.

Because the short waves are becoming more important, the receiver is tuned with standard plug-in coils so that you can receive all waves from fifteen meters up to the highest in the broadcast band.

WHILE the beginner will be wise to follow the exact construction shown, you can, of course, eliminate the plug-in coils and substitute a fixed hand-wound coil if you do not want to receive the short waves. POPULAR SCIENCE MONTHLY Blueprint No. 97, now available, gives details on this point as well as the regular construction and wiring. A complete list of the parts actually used in constructing the receiver also is available, but in order to make the construction as economical as possible the design has been worked out so that there is considerable latitude for the selection of different makes of parts.

Since the complete receiver will be of the simplest possible full electric type, a novel arrangement is presented in this article for the operation of one tube. A single heater-type 227 tube is used, and as the picture wiring diagram of Fig. 3 shows, a filament heating transformer supplies the A-current to this tube. This filament heating transformer can be obtained at less cost than any standard stor-

age battery, and the same transformer will be used to operate all the tubes to be added later. By this arrangement you get rid of the A storage battery and the necessity of charging it, or the use of a less efficient dry cell type tube that would have to be discarded later on anyhow.

For B-current, a standard 45-volt dry cell unit is employed. Such a battery will give good service on a one-tube set of this type for over a year. Ultimately a special B eliminator will be described

storage battery tube such as the 201A. Blueprint No. 97 includes a picture diagram covering the changes needed if battery operation is necessary.

PERHAPS you will recognize the similarity of the circuit to the one-tube short wave adaptor unit shown in the August, 1928, issue of POPULAR SCIENCE MONTHLY. The only essential difference is in the control of regeneration. Instead of using a variable condenser, the new circuit makes use of a variable high resistance. Either method of control gives good results, but the resistance method is a little easier to operate, as there is not the tendency to "pop" into oscillation as sometimes is the case with the condenser.

You will need these parts to build this modern one-tube receiver:

- A1-B1-C1—short wave coil set, including tuning and extra coils to cover the broadcast band of wave lengths.
- D1—variable condenser, .00014 mfd. capacity.
- D2—grid condenser, .0001 mfd. capacity with clips.
- D3—fixed condenser, .0005 mfd. capacity.
- E1—radio-frequency choke coil, 85 mill henries inductance.
- F1—grid leak, 5 megohms.
- F2—variable resistance, 0 to 5,000,000 ohms.
- G1—socket for heater type 227 vacuum tube.
- Drum dial, panel 7 by 21 inches, baseboard $\frac{1}{2}$ by 10 by 20 inches. Wire, screws, etc.

THE tuning unit in the model receiver has a base which is mounted in the location shown in Fig. 2. Changing the wave length range of the receiver is merely a matter of plugging a different coil set into this base.

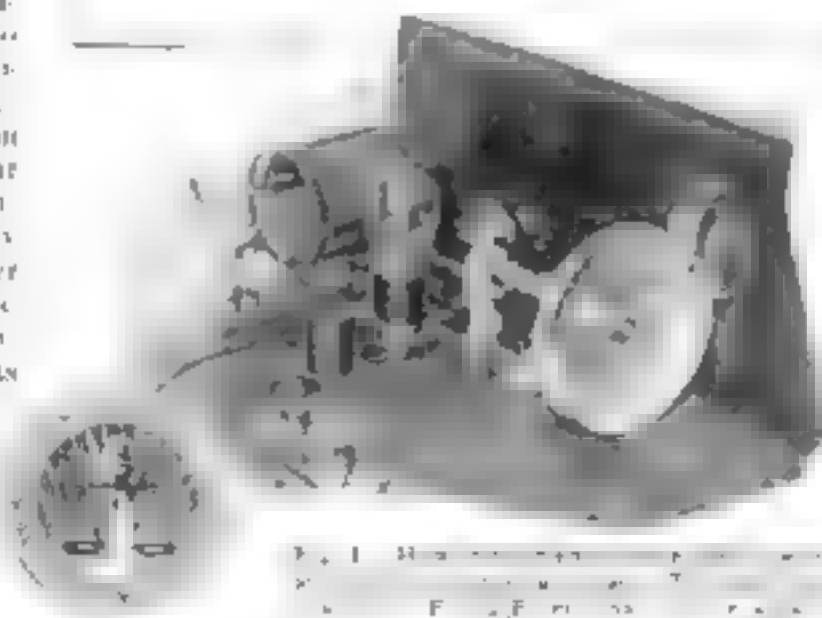
None of the other parts require special mention except, perhaps, the variable resistance F2 and the drum dial. The variable resistance is of the graphite compression type. Other types could be used of course, but they might require a different value of fixed condenser at D3. Almost any type of drum dial can be used, if it will fit into the space provided and can be connected to the condenser where shown. In the model receiver the variable condenser D1 has a detachable shaft which can be pulled



The attractive front panel, up-to-date in every way.

POPULAR SCIENCE MONTHLY Blueprint No. 97, describing in still greater detail the construction of this modern one-tube radio receiver, is now available. It can be obtained for 25 cents (see page 100).

A complete list of the parts approved by the Popular Science Institute of Standards for use in constructing this one-tube receiver will be mailed with each blueprint, or will be mailed without charge to readers who do not desire the blueprint. Address requests for advice or information to: Radio Editor, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York.



that will supply the B and C voltages and so make the completed receiver full electric.

In localities where no 110-volt alternating current is available, the constructor must use either a dry cell type tube such as the 189, or the ordinary

out far enough to project through the drum dial and out the other side. This construction simplifies mounting and will make it easy to add another condenser later on the other side of the drum.

The size of the panel can be increased to 7 by 24 inches and the baseboard to 10 by 23 inches if you want still more room around the instruments to do the wiring. Do not attempt to use a smaller panel or baseboard than specified if you plan to enlarge the receiver. Of course, if you wish to make this a permanent one-tube outfit, you can use as small a panel as will allow the parts to be mounted.

A STUMBLING block for most beginners is to obtain a baseboard that is not warped. The baseboard of the model receiver was made of several layers of thin plywood like that used on the sides and ends of many types of packing cases. After a sufficient number of layers of this thin wood had been cut to the proper size, they were placed on top of one another and rows of small wire nails were driven through and clinched on the other side. This makes a strong construction that is not likely to warp, and the material usually can be had for the asking.

The panel also is held to the baseboard by a novel method. Instead of using ordinary wood screws driven into the edge of the base, No. 6-32 brass flat head machine screws were used and holes were drilled into the edge of the base with a No. 27 drill. Then $\frac{3}{4}$ -inch holes were drilled down through the base across the ends of the small holes. The machine screws were pushed into the small holes through the panel and the base so that the ends protruded into the vertical $\frac{3}{4}$ -inch holes, where brass nuts were threaded on them and the screws pulled up tight. This method would not be necessary on a solid baseboard, but ordinary wood screws would be likely to pull out of holes drilled into the edge of several thin boards that are simply nailed together. The $\frac{3}{4}$ -inch holes are visible in Fig. 2.

IN MOUNTING the drum dial follow the instructions of the manufacturer as accurately as you can. Mount all the rest of the parts according to Fig. 3. Extreme accuracy is not necessary in the placement of the parts. Follow the layout as nearly as you can by eye measurement. Make sure, however, that the base of the tuning unit A1, B1, C1 is exactly at right angles to the front panel.

The wiring should present no difficulties. Simply follow the pictorial wiring diagram shown in Fig. 3, or the technical diagram in Fig. 4. Note that the rotary plates of condenser D1 (the frame connection) are connected to the K binding post of socket G and one terminal of resistance F2.

The coil mounting has two binding posts connected by flexible wires to coil A1, which is attached to the mounting by a hinge. The antenna and ground leads are clamped under these binding posts as indicated. The four sockets for the four plugs on the detachable B1, C1 unit are marked P, P, B and G, reading from the antenna and ground binding posts.

The two binding posts for the head-phone cord tips are for use while the outfit is used as a one-tube set and will be removed when other parts are added to

electric light socket. Nothing will happen for from 15 to 45 seconds, and then you will notice that the center electrode in the tube has become a dull red. Wait until you notice no more change in the color of the electrode and then slowly screw the knob of F2 toward the panel. Considerably before the knob reaches the limit of movement you will notice first a slight hissing and then a faint click. Now turn the dial until a whistle is heard. Stop at that point and immediately turn the knob of F2 out until the whistle disappears and the broadcasting will be heard with reasonable volume if it is a local station.

NEVER operate the receiver with the knob of F2 screwed in so far that a whistle, changing in pitch, can be heard when you tune the dial back and forth across the wave of any station. If you do you are likely to interfere with your neighbors' reception. If you keep the knob always out far enough so that no squeal can be produced, you will cause no interference.

You may find that the whistle cannot be produced at certain points on the dial. That difficulty can be remedied by turning coil A1 farther away from coil B2. You are most likely to notice this dead spot effect on the shorter waves. Broadcasting on the shorter waves is received in the same way as on the regular broadcast band with the set in a non-oscillating condition. Short wave amateur code work always is received with the knob of F2 turned in just beyond the point where the click is heard and where the dots and dashes are heard in a chirpy tone that warbles like a canary with the asthma.

DO NOT expect too much from a one-tube set. It cannot equal a larger set for distance, selectivity, or volume. Expect those desirable features only after you have added tubes to the set according to instructions that will appear in future articles.

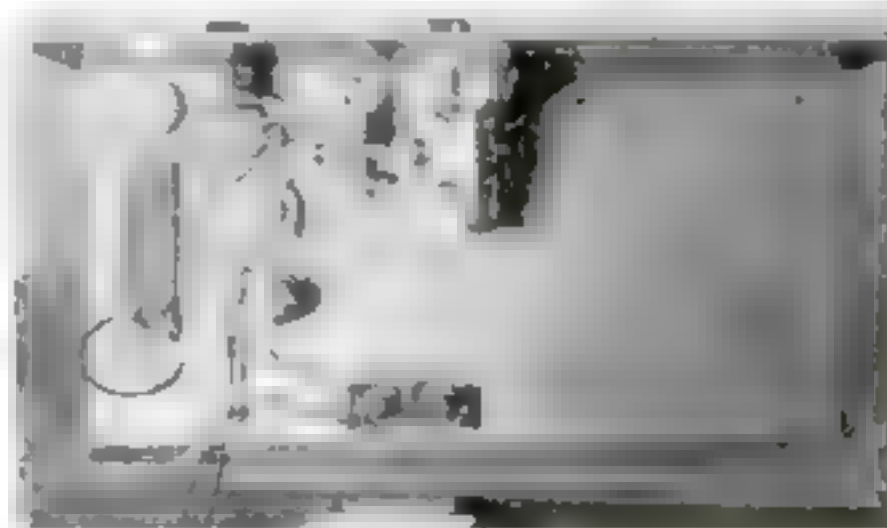


Fig. 2.—Follow this arrangement in laying out the instruments on the baseboard. Be sure that the tuning coil mounting, shown at the extreme left, is put in a position exactly at right angles to the panel.

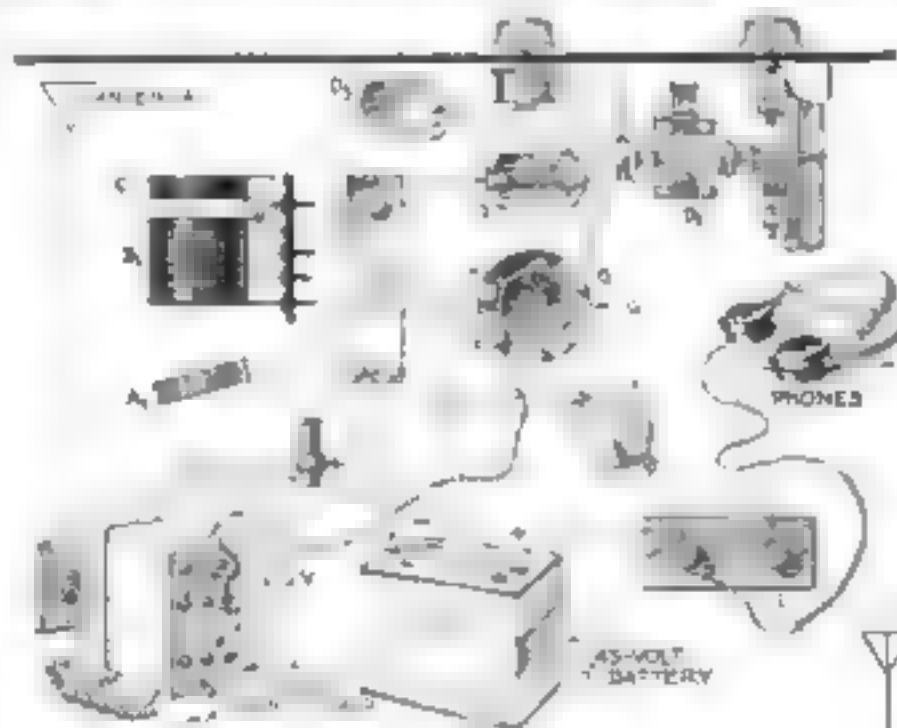


Fig. 3.—Pictorial diagram for the beginner, showing layout of parts and complete wiring of the one-tube receiver including connections for power supply, headphones, and coils.

wired and you have carefully rechecked your wiring, connect the twisted cord from terminals P and P of socket G to the 21 $\frac{1}{2}$ -volt terminals of the A-power transformer. Then connect on the B-battery, the antenna, the ground and the headphones as shown in Fig. 4. The antenna should be a single wire about one hundred feet long and as high as possible.

Screw the knob of the variable resistance F2 out as far as it will go, put on the headphones, insert a 1A 227 tube in socket G1, and plug the cord from the A-power transformer into the nearest

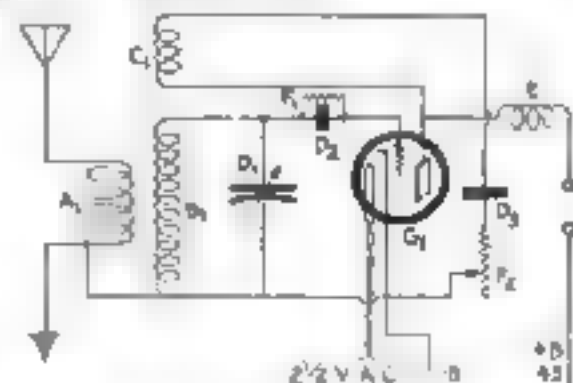


Fig. 4.—Technical wiring diagram. Regeneration is controlled by a variable high resistance.

Distant stations may be heard with the one-tube set at times when conditions are just right on the broadcast band of wave lengths. Of course, a high and long antenna is needed for best results in distance. On the short waves you may hear amateur stations operating in all parts of the world if you are in a good location.

Strange Colors We Can't See

Surprising Tests Explain Why Some Folks, Like Bees, Are Blind to Red and Green How Our Eyes Catch Rainbow Hues

By P. A. CARMICHAEL

THIS would be a dreary world if everything in it were either white or black, and man never saw any color but those. To look at a deep red rose and see only a cluster of blackness, to find the leaves of a tree all a dull white; to see a clear sky as a dome of granite gray, to get from the sight of leaping flames only the impression of fog—all this could happen only in a strange, fantastic world.

But that depends on whose world it is. There are people and creatures who have not the powers of sight which a normal human being has, for example, persons totally color blind—and, oddly enough, cats. They see the same things that we see, but theirs is a world of black and white.

Then there are others whose sight is not confined to black and white still misses many of the colors we see. A bee is such a creature, and so are most fishes. They see only blue and yellow. All else is black or white, or some shade partly black and partly white.

A noted scientist, Prof. K. von Frisch of Munich, Germany, experimented on bees to discover what colors they see. In an aviary he coated certain blue objects with a sweet substance. Other objects of thirty-two different shades of gray he left uncoated. The sweet coating quickly

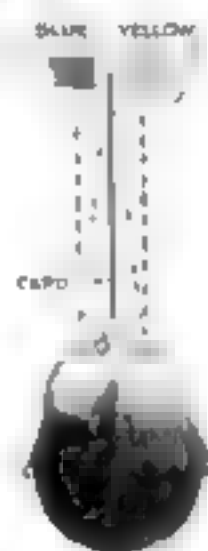
TRY this test: Holding a card edgewise between your eyes as a screen, as shown in the diagram, try to see blue with one eye and yellow with the other at the same time. You'll find that you see the two colors as one—a kind of white. This test, say experts, supports the theory that ancestors of man saw only white and that our color perceptions are a result of evolution.

drew the bees to the blue objects, the gray objects they left untouched. In a few days the bees had learned to look for food on all blue objects and not on gray objects. Amazingly, when he placed in the aviary new objects colored blue and gray but without any sweet coating on either, the bees immediately flocked to the blue as before, and again passed the gray by. Clearly it was the blue color that drew them, not the coating.

Using yellow objects in similar experiments, Professor von Frisch then educated the bees to look for food wherever they saw yellow. Next he tried red and

black. Try as he would, however, he could not induce the bees to distinguish between those two colors. Next he tried them on green. This likewise, they failed to distinguish.

It was clear, then, that the bees recognized only two fundamental colors—blue and yellow. They could distinguish only half of the colors that the normal man can distinguish (the normal being blue, yellow, red and green, with their combinations).



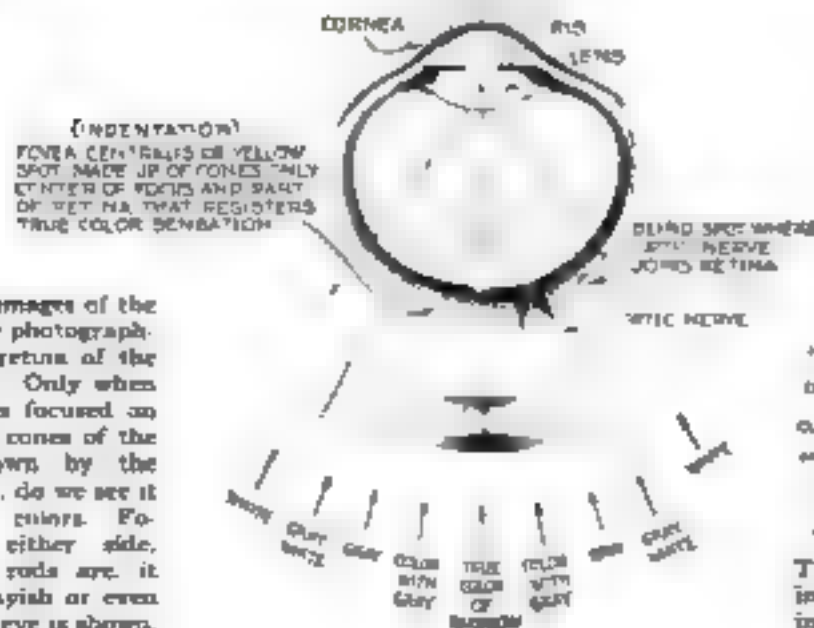
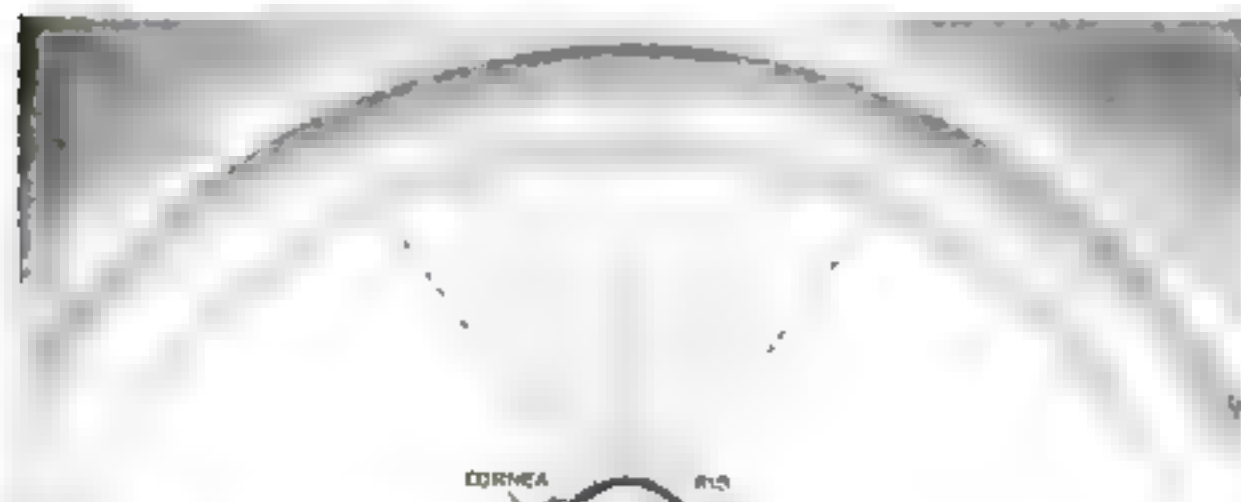
Oddly enough, the two colors which the bee sees are just the ones to which, as a rule, partly color-blind persons are limited. They cannot tell brown from red or green in daylight, nor red and green from each other. This is a handicap, especially in driving an automobile, because of the red and green traffic lights. I know one such color-blind person, however, who learned a trick that saves him trouble. He observed that the traffic lights were so arranged that the green, or "Go" light was on top, the amber or "Caution" one in the middle, and the red or "Stop" at the bottom. Though all looked alike to him, he learned to identify them by their positions.

However, traffic lights nowadays usually are not pure red and pure green. In the red ones there is a tinge of orange, and in the green a bit of blue, making them distinguishable to many partly color-blind persons.

JUST how the eye distinguishes colors long has puzzled scientists. The newest theory is one recently advanced by Dr. Christine Ladd-Franklin, of Columbia University. To comprehend it clearly requires first an understanding of the structure of the eye. The back part, or retina, of the eyeball is like the inside of a saucer.

On it are cast the images of everything that we see, just as images are cast on a photographic plate—the eye itself being simply a highly developed camera. The retina is made up of a vast number of little instruments, called "rods" and "cones" because of their shape. The cones are concentrated at the center gradually thinning out and giving way to the rods at the rim.

It is near the center of the retina, in the spot
(Continued on page 150)



How color images of the rainbow are photographed on the retina of the human eye. Only when an object is focused on the central cones of the retina, shown by the indentation, do we see it in its true colors. Focused on either side, where the rods are, it appears grayish or even white. Left eye is shown.

The intricate structure of the retina, showing arrangement of rods and cones, the instruments which give us color sensations.

Hunt Diamonds in the Sea

By
ELLSWORTH BENNETT

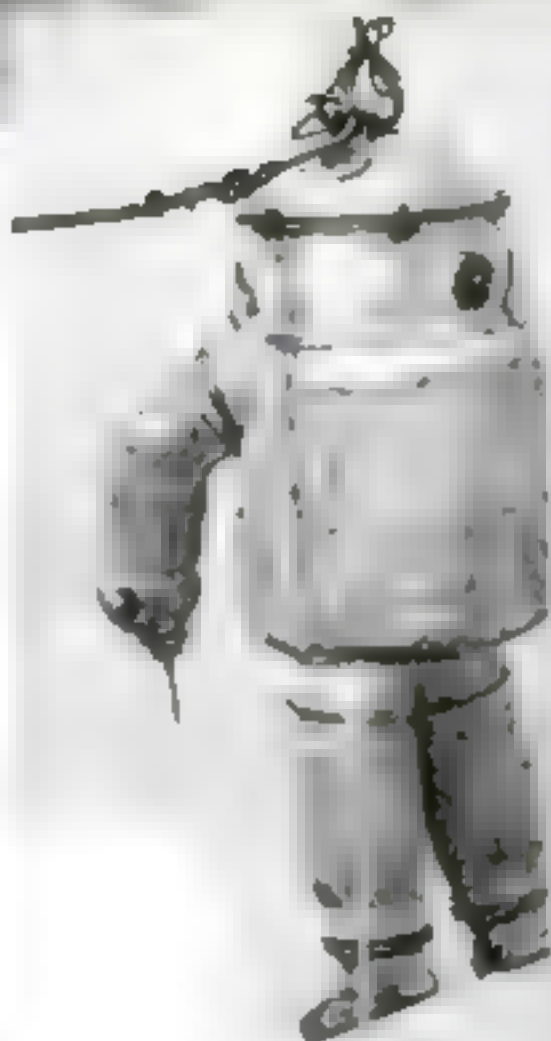
A powerful electromagnet, lowered from an Italian salvage tug, recovers car wheels located by divers using the new equipment.

ONE of the oddest of treasure hunts ended at Saint Nazaire Harbor, France, the other day, after a successful test of new deep-sea diving apparatus of German design. It had recovered 2,000 francs in Belgian currency notes, a few coins, and a packet of papers from the captain's safe in the deserted Belgian steamer *Elizabethville*, sunk in two hundred and forty feet of water off Belle Isle, situated south of Brest on the French coast in 1917.

Though 13,000 carats of diamonds believed to be aboard the sunken ship were nowhere to be found, a valuable cargo of ivory was disclosed that may yet be salvaged. More important still, the first practical test of the deep-sea diving equipment forecast possible future recovery of some part of the quarter-billion dollars worth of gold and gems, besides ancient art relics, scientific records, and zoological specimens of untold value known to be in wrecks that have sunk to the bottom of the sea.

Hitherto terrific water pressure at great depths has barred attempts of divers to reach these wrecks, since it would crush a man in a rubber diving suit. The all-metal diving armor was chosen by an Italian salvage concern that organized the latest treasure search. In this outfit cast steel cylinders form the body of the suit, with jointed iron legs and "mechanical arms" with steel hooks for hands. Oxygen flasks within dispense with the usual diver's air line, though a telephone line keeps him in communication with his ship. In the air, the ponderous suit weighs 800 pounds; in the water, only forty. With such an outfit, it is reported, a diver can descend rapidly to great depths with no discomfort.

WHEN the apparatus was first tried out during salvaging operations on a sunken wreck in Italian waters, divers using it recovered valuable railway material. Heavy car wheels and similar objects were hoisted to the surface by large electromagnets lowered into the water from



A diver in the new deep sea armor being hauled from the water after a search for treasure forty fathoms under the sea. Right: The rusted steel safe recovered from the wreck of the steamer *Elizabethville*.

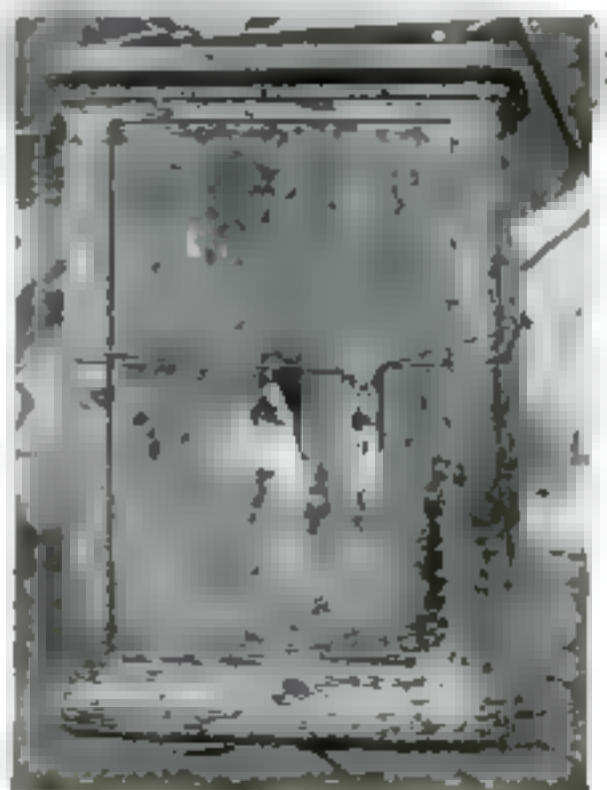
the salvage tug *Raffia*. Immediately it was decided to search for 13,000 carats of diamonds and quantities of other gems reputed to have been in the captain's custody aboard the Belgian steamer *Elizabethville*, sunk by a German submarine during the World War.

Forty fathoms deep lay the *Elizabethville*, broken in two on a flat submerged rock. Fish were swimming through the engine room. To get into the strong room, where the diamond treasure was supposed to be, divers placed dynamite charges that blew a hole in the deck.

Instead of diamonds, when they entered the hole, they found stacks of shells

originally provided for the ship's guns, and a cargo of elephant tusks beneath the forecabin. One promising object proved to be a gold-plated safety razor, which a diver picked up with his mechanical hand and carried to the surface. Up forward in the captain's cabin, however, a rusty steel safe came to light. The roof above it was blown off with dynamite and the safe was hoisted aboard the salvage ship with a derrick and powerful magnets. When it was broken open, no diamonds could be found, indicating that if the vessel still contained treasure it lay beyond hope of salvage. Tons of material had been brought to the surface, and the diving equipment had functioned perfectly at twice the depth long considered the limit for safe diving operations.

The diving armor, it is announced, will be used to salvage treasures from other wrecks sunk in the sea.



Useful New Creations Of Inventive Minds



The "pick-up" of automobile motors with various fuels and carburetors is tested with this new device by the U. S. Bureau of Standards. A motor runs a strip of paper between two electrodes which produce electric sparks at regular intervals. The closer the holes made by the sparks, the faster the motor.



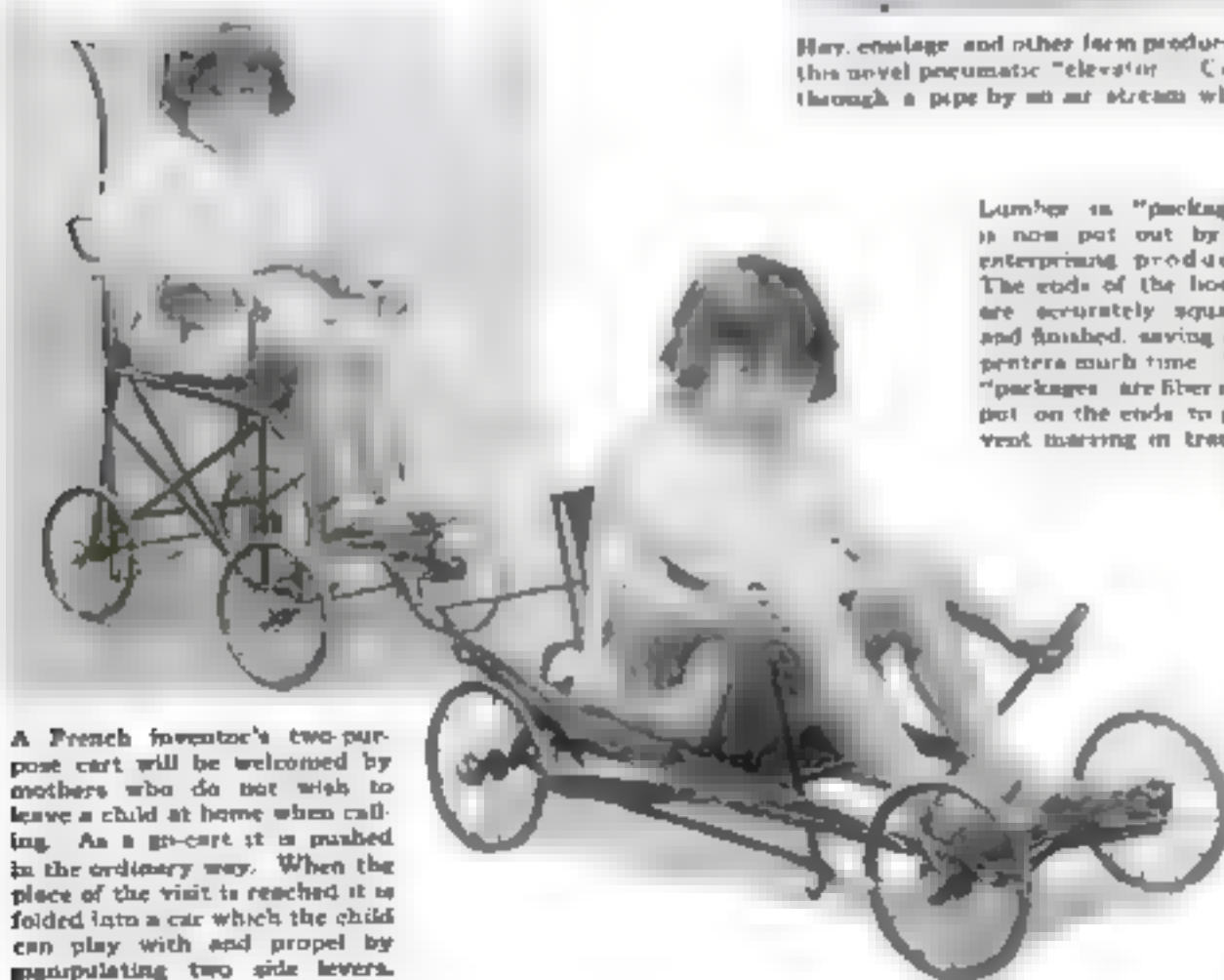
With this new oxygen helmet demonstrated by a Los Angeles fireman, one can spend many minutes under water or in stifling smoke. A clip closes the nostrils and oxygen from a tank carried on the back is breathed through mouthpiece.



A cigarette holder that does not go to the mouth and yet protects the fingers from tobacco stain is this wide ring of composition material, which fits like a collar around the end of the cigarette where it is held between the first and second fingers of the hand.



Hay, ensilage and other farm produce are speedily moved into silo or barn with this novel pneumatic "elevator." Cast into a hopper, the material is carried through a pipe by an air stream which is produced by a machine-driven fan.



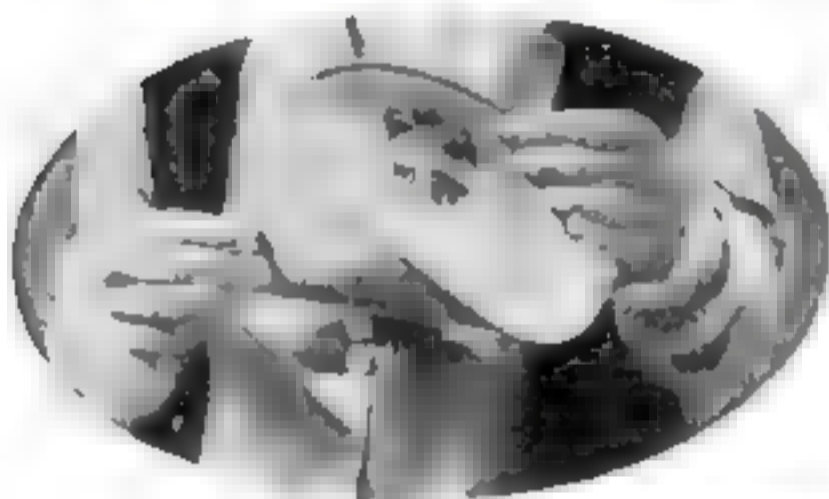
A French inventor's two-purpose cart will be welcomed by mothers who do not wish to leave a child at home when calling. As a go-cart it is pushed in the ordinary way. When the place of the visit is reached it is folded into a car which the child can play with and propel by manipulating two side levers.

Lumber is "packaged" is now put out by an enterprising producer. The ends of the boards are accurately squared and finished, saving carpenters much time. The "packages" are fiber rope put on the ends to prevent warping in transit.





A marvelous new egg grading machine recently shown in England is based on the fact that the weight of eggs varies in accordance with their quality and freshness. The eggs roll down tracks divided in sections, each of which is hinged in the middle and so balanced that when an egg above a certain weight reaches it, the track swings downward, permitting the egg to roll to its proper bin.



After being run over in the street by a motor car and then rolled up and unrolled, a remarkable new talking machine record reproduced music perfectly in a recent demonstration in London. The record, invented by J. Goudon, is flexible so that, no matter how it is folded or bent, it can be restored to its proper shape and the fine impressions which reproduce sound are unchanged.



This German machine which saves hours of labor wherever money is handled in quantities can take care of a peck of coins. It distributes them by denominations into the bags, counts them, and finally gives the grand total.



When the Coast Guard vessel *Marion* recently set off for the north Atlantic to study icebergs it took along this unique instrument, shown by Lieut. Commander E. H. Smith to raise water from the cold depths so that its peculiarities may be scientifically studied.



"Hit-and-run" drivers and traffic law violators generally will not escape so easily if these new luminous automobile license plates, now being tried in Melbourne, Australia, are required by law. The numbers shine out visibly for many blocks. This invention will also serve as an aid to police in identifying stolen automobiles.

Stenographic labor is saved and efficiency increased with the notebook holder and transcription stand seen in the illustration below. The metal back holds the book with a clamp. Sheets fold up and are held under a metal cover as they are finished and the cover also carries clips to hold special memoranda. When it is time to transcribe, a folding leg transforms the back into an easel.



"Lew" Barber (right), English motorcycle racing champion, shows the helmet he invented for comfort in driving and protection in case of a crash. Goggles drop over eyes; slits in the mask admit air. The top protects the skull.



Cities in Race for Airports



Bird's-eye view of Lindbergh Field, San Diego's new municipal airport, during recent dedication ceremonies. Swarms of Army and Navy planes are seen flying overhead.

New Engineering Science Shows How to Develop Flying Harbors to Replace Mere "Landing Fields"

By ROBERT E. MARTIN

ABAND was playing in a level, weed-grown field. Near by stood a group of prominent citizens, some of them muttering the rehearsal of speeches soon to be delivered. Less prominent citizens and their children craned their necks to watch airplanes overhead. Hot dogs, bottled drinks, and ice cream pies were being sold by such hawkers as were not peddling toy "Lindy airplanes" and toy balloons. It was a gala occasion. The local airport was being dedicated.

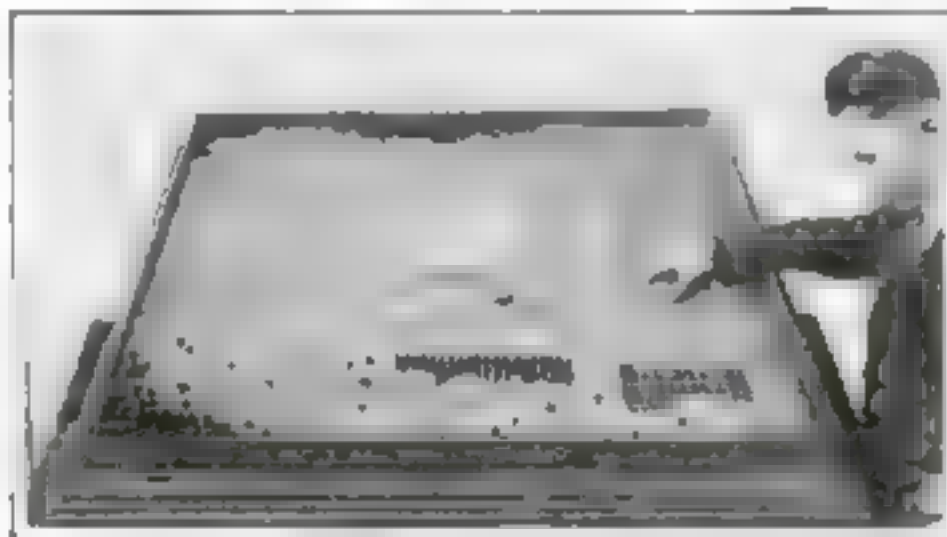
"Where?" you may ask.

Well, Rockville Centre, a Long Island village, was one place where this happened recently; but it also happened at Towanda, Pa.; Colorado Springs, Colo.; Mount Morris, Ill.; Fort Dodge, Iowa; San Diego, Calif.; and Austin, Minn.—all within a few days. It has happened hundreds of times, and during this year will happen hundreds of times again. The latest report of the Aeronautics Division of the U. S. Department of Commerce lists 331 private and commercial airports, 256 intermediate landing fields, 64 Army and 17 Navy aviation fields, 326 marked auxiliary fields, and 754 proposed airports. By this time next year America will have more than 1,700 airports.

At the close of the Civil War, America

was a continent more than three months wide, today, by the best trains, it is three days wide, in a few years it will be half a day wide. A few adventurers already have spanned the continent during daylight. It will be no wider than that for all of us when there are suitable airports in every American community.

Lack of good airports is a brake that retards further development of aviation.



Courtesy General Electric Company

Airport design offers a new field in engineering. This scale model for an airport at Schenectady, N. Y., shows arrangement of landing strips, hangars, and administration buildings, in reference to highways, as seen from the air. The field has guiding beacons, boundary markers, and floodlights.

A few of the many we have now are excellently designed and suitably located, but the majority are mere landing fields called "airports" in a booster-spirit courtesy. But a landing field is not an airport.

At this writing Chicago is projecting an airport on reclaimed land on the shore of Lake Michigan. It is closer to the heart of the city than the railroad terminals, and less than five minutes taxicab ride from the best hotels. But the airport which Chicago has been using is more than an hour from the loop district. Cleveland's is nearly as far from the business center. That is something established

business cannot permit, because unless the airports are brought to business, business will gravitate to the airports. That happened with railroad terminals, and inevitably it will occur with airline terminals.

IT IS recalled in Missouri today that St. Joseph, Mark Twain's town, adopted a high hat attitude toward the first westward rail line. St. Joseph, as the terminus of the pony express, had been richer and larger than Kansas City. Kansas City, though, went after the railroad—and the railroads came to Kansas City. Today the comparative size of the two cities justifies the vision of the citizens of

St. Joe's neighbor.

Then air lines were coming, even as the railroads had come. This time Saint Joe was not asleep. She bought 100 acres of land and built an airport; and Kansas

City, forty miles away, lost the distinction of being a stop on the Chicago-Dallas air route.

Rivalries of railroad building days are being revived in multitudes of communities. Hundreds of villages are stirring with freshened hopes of greatness.

Already some 11,000 Americans have learned enough about flying to apply for pilots licenses. There are nearly ninety airplane models on the market ranging in price from \$1,063 to \$600,000, and in horsepower from forty to 1,000. Tons of freight and hundreds of passengers are being transported through the air every day. The means for airplane transport are here; only the conveniences are lacking.

AN AIRPORT, first of all, must be so marked that it is readily visible to the pilot of an approaching plane. By day it must advertise its presence with the great white circle that means "landing field." By night it must swing a silver beam of light against the sky as a beacon.

New York's night sky is riven unceasingly by ghostly fingers of light revolving clockwise. On clear nights these are visible from the mid plane over a distance that would have been a two weeks' journey for one of the ox-drawn covered wagons of pioneer days. One is sent from a twenty-four-inch rotating beacon at Roosevelt Field, Long Island; another from a New York City hotel, and still another from Port Newark, twenty miles away. Cunningly, these lights have been mounted on steel towers so that their thirty-second or sixty-second revolutions shall not interfere with the slumbers of ground folks.

Beacons, however, are but one unit in the intricate lighting system vital to airports. Installed along the runway borders of the best equipped are boundary lights at intervals of about 250 feet mounted on pipe supports. Red glass globes warn the descending flyer of field obstructions, green globes indicate the best line of approach for landing. Illumination that will transform an airport into a plane of brilliance, yet free from glare, is obtained by means of twin flood lights that confine their beams to a low altitude, and minimize glare. The beams are directed against the wind, since airplanes must land into the wind. Wind cones also must be illuminated for night flyers, and there must be ceiling lights to show the height of clouds above the ground.

A real airport, though, requires much

more than effective lighting. Eleven miles from Detroit is the Dearborn Airport, a Ford enterprise, called by aviators the most convenient and efficient aviation field east of the Mississippi. There 350 acres of field as level as a pool table are inclosed by a high wire fence. From the sky the approaching flyers see a row of rectangular buildings, an airplane factory, an engineering laboratory, a power plant, and a hangar of steel and concrete that can shelter seventy-five planes.

In front of the buildings is a concrete apron 100 feet wide and half a mile long, and radiating from this are three concrete runways, two pointing to the southeast and one into the southwest. One is 3,500 feet long; the other two about a thousand feet each. They provide ideal take-offs. In the space between them the ground has been grubbed free of heavy roots and stumps, harrowed, seeded, and rolled.

The Dearborn Airport has every modern appliance for rapid repairing and servicing of an airplane. Wings can be replaced, engines taken down and reassembled, new propellers applied, gas tanks filled and oil drained and changed with an economy of time that compares well with similar sort of service for automobiles along the highways. When passengers from Chicago

or elsewhere debark they find luxurious automobile buses waiting to carry them swiftly to Detroit hotels or railroad stations. Twenty planes arrive and depart from the Dearborn Airport every day except Sunday. Still, Detroit is not satisfied with the arrangement. Her business men are demanding facilities within the heart of the city. The Detroit airport which they are planning will be tied into every other thread of the city's life. It will connect with trains, street cars, taxicabs, buses, and if arriving visitors wish to enter a hotel without delay, the hotel will be there.

LOCATION, then, is the prime convenience. Buffalo has a 318-acre airport eight miles from the heart of the city. It is becoming apparent that either it will have to move into town or that an important part of Buffalo will move out to the airport.

In recent years the New York air mail field has been near New Brunswick, New Jersey, midway between New York City and Philadelphia. It was too far. Overnight air mail that reached Hadley Field at 4:45 A.M. was left lying there for two hours waiting for a train to carry it into New York. That was obviously a stupid waste of time. On October 1, the situation was partially corrected. The New York air mail now is picked up and delivered from Port Newark, a combined landing place for air ships and ocean ships, developed by Newark, N. J. Mail from the West arrives at Newark at 4:45 A.M. Thirty-five minutes later it is being sorted in the New York general post office for morning delivery.

One of the towered beacons that guide night flyers to landing fields. This one is near Burns, Wyoming.



Site of New York City's projected airport on Barren Island. White stretches in the foreground are sand, which will be covered with clay and sod for the landing field. At the left Clarence Chamberlin, trans-Atlantic flyer and superintendent of the project, is pointing out the location of the site to Peter J. Brady of the New York State Aviation Commission.

In every town where the airport question has not been settled there is a conflict of opinion as to where it should be located. One group of citizens believes that the best location is where land is the cheapest; but almost invariably they are wrong. The best place is where the airport can give the best and safest service.

In the matter of costs, the price of the land per acre is the least consideration. A new kind of engineering is involved here. What will (Continued on page 152)

Queer Birds Worth Millions

Here is an elderly guano bird with her eggs, and across the way is a lusty youngster. Most valuable of all birds, their sole use in the world is to fly around catch fish, and produce tons of fertilizer.



The World's Most Valued Feathered Tribe Fly in Vast Clouds That Hide the Sun. On Their Crowded Island Homes They Supply Fortunes in Farm Fertilizer

By

HOMER CROY



IT'S a queer, strange story about the most valuable bird in the world. The bird is never sold, never skinned nor dressed; its feathers have no use. Its eggs serve no useful purpose except to raise more birds, no human being ever ate it, and it is rarely seen by the ordinary person.

It is the guano bird, and it lives off the coast of Peru.

Its sole purpose in the world is to fly around and catch fish, have a good time, raise its young—and produce guano. Guano is used as a fertilizer, and is thirty-three times as strong as barnyard manure. It has supplied a billion dollars' worth of fertilizer for the farmers of Peru, South America, England, and the United States.

The number of birds is amazing. Recently, traveling along the coast of Peru, I was astonished at the numbers of the flocks. One sees them in great black rivers flowing through the air—great Streams of the sky. There are millions and millions of them, turning this way, flowing that way, bending in great curves, then thinning out until they look like a long black rope whipped through the sky by some gigantic hand.

In the late afternoon, just before sunset, the birds are thickest, for they are flying home to their bird islands off the coast of Peru. They obscure the sun like an eclipse. Indeed, they are so numerous that on Central Chincha Island alone they eat one thousand tons of fish a day!

Why are these birds more numerous there

than any other place in the world? The answer is the Humboldt Current that flows along the west coast of South America, keeping that section cool, while the east coast is hot and sultry. This cool water is the breeding place of myriads of small fish. The birds eat the fish, live on the uninhabited islands, and produce guano. Very simple, very useful.

Men come and take the guano away. The birds are merely a cog in a machine of turning fish of the Humboldt Current into food for the table and clothes for the back. They might be called converters—fish converters.

I made a visit to some of these guano islands and here are some of the queer and unusual things that impressed me.

The tameness of the birds, that was one. As you walk along you can hardly keep them out of your way. It's like going into a chicken yard with a bowl in your hand. If you stand still they will walk on your feet and look up at you, turning their heads from side to side as if saying, "Why, what a queer looking creature this is. I don't believe it can fly at all."

Their sense of hearing doesn't seem to be well developed, and I can understand that it may not be, for the noise of these

flocks is deafening. They keep up an incessant chatter and squawking, if they are frightened or start to fly, it sounds like the roaring of a train in a tunnel. If you fire a gun into the air it doesn't frighten them, but if you make a sudden, unexpected movement there will be a beating of wings, a squawking, and away they will fly.

Such a bedlam! Millions on one island, all crowded together, so thick that they cannot all rise at the same time. A few start here, there is a roaring, humming, tearing sound, and another black

cloud rises. When they are all at home at one time they cannot walk about, but are like fowls packed in a railroad chicken car.



Workmen filling the sacks. The white is the guano, the black is cleared ground. Here the deposit of guano is about two feet thick.

They are getting here! When the birds see to fly, the roaring of wings is like a train in a tunnel. Workmen are quiet as the birds approach.

A queer thing was that these birds seem to have "goats"—that is, birds which they pick on and play jokes on. Whether it is always the same bird I don't know. The flock will be sitting still when all of a sudden one of its members will start a bird running, and the "goat" will make a bee-line through the others with its head held high, screaming at the top of its voice, while all the other birds peck at it. The "goat" bird keeps on going, never ceasing in its wild clamor, until it reaches a cleared space. There it stands, sympathizing with itself, and after a time it creeps back, looking very foolish.

THEY seem to have laws all their own. One concerns the stealing of feathers. Feathers are their money, for nothing grows on these rocky barren islands; not a living twig, not a mouthful of food. The birds prize feathers to soften their nests, so now and then an outlaw bird goes on a feather-stealing expedition. The bird who is robbed sets up a squawking, and then the other birds rush out and, making a terrible noise, set upon the thief.

The birds become encrusted with guano and when it becomes uncomfortable they fly out to the ocean for a bath. They poise above the water, then fly at it at terrific speed. When they strike the water it sounds like the dull report of pistols. They rise again and repeat it time after time, thrashing the water with their wings. When a flock is bathing it sounds like distant musketry.



Their nests surprised me. Feathers are used to soften them but the nests are of the guano itself beaten into place by the birds' wings. Great, huge nests they are. Often they weigh twelve pounds, and here the birds lay their eggs and raise their young.

But it is not all a life of Riley for the guano birds. One of their worries is the birds of prey that swoop down and eat their eggs. The South American condor is one, he comes from the high Andes. One condor which was killed was found to have sucked twenty eggs into its gullet.

But the guano bird has a friend who

helps him fight his enemies. It is the sharpshooter employed by the government of Peru to kill the enemy birds. The condor offers an easy target, but the gulls and vultures are small and they are cunning. However, the sharpshooters know how to deal with them. They take a wounded gull or vulture, tie a bag of sand to its leg, and then leave it. Its cries draw other birds of its kind, and the sharpshooter disposes of them.

So far I have told only about the birds. Now I'll tell something about the guano and how it is handled.

It's not a very pleasant job, mining guano, and only the lowest class of labor goes in for it. When the men are first taken to the islands they are not required to work for a week, for the government knows that it will take them that long to get used to the odor. But after a short time they no longer seem to mind it.

The workmen, with picks and shovels, break up the guano deposits and put it into bags. After they have gathered all



A queer feathered mob poses for the camera. The birds are so tame that they'll walk on your feet and have to be kicked away.

Peruvian guano "miners" sewing up the sacks of fertilizer. It takes at least a week for the workmen to become used to the strange odor.



Beyond the railroad, the farmers of Peru hoist the bags of guano on their backs and carry it away to the hills.

they can with shovels, they take stiff brooms and sweep it up, even the dust. The bags are sewed up, put on dummy railroads, and taken to the edge of the islands. The rocky shore of the islands is usually high, and below are the ships to be loaded. Sometimes the bags are sent down through chutes and canvas tunnels, or put on wire trolleys and swung down. After a ship is loaded it sails away with its powerful fertilizer.

After an island has been cleared it takes about thirty months for it to be ready again. So the guano workmen go from island to island, year in and year out, harvesting their strange crop.

Guano is no recent discovery, and its use as a fertilizer is nothing new. It was used by the Incas, in the days before Pizarro came and fastened his bloody yoke upon them. The Incas sailed out in their crude boats, loaded them with guano, and sailed back again. Reaching shore the guano was put into woven baskets and carried by man power high into the mountains, and then scattered on the amazing little terraced farms.

AND it is still being handled that way, in the back regions of Peru. It goes part way by railroad, then the farmers come with their bags and, chewing their coco leaves, start for the high altitudes.

When modern methods were first applied to the gathering of guano it was found in some places, to be one hundred and fifty feet deep. But today it is allowed to get only a few inches deep before it is gathered.

We stopped at a small house where the workmen lived. It was meal time and the men were sitting at rough tables, eating their food and drinking their wine. On a shelf I noticed two bottles which seemed to be beautifully painted. On one was a beautiful sunset; the other showed a series of mountains, with white caps of snow.

"What do you think those are?" the manager asked.

I did not know.

And then he told me. One of the workmen, with artistic bent, had taken different colored guano, put it into empty wine bottles, and had worked it in so cleverly that it looked like painting.

And suddenly, in those bottles, I saw how heavily time must hang on the men's hands and the tragedy of having to live always on a guano island.

It was late afternoon when

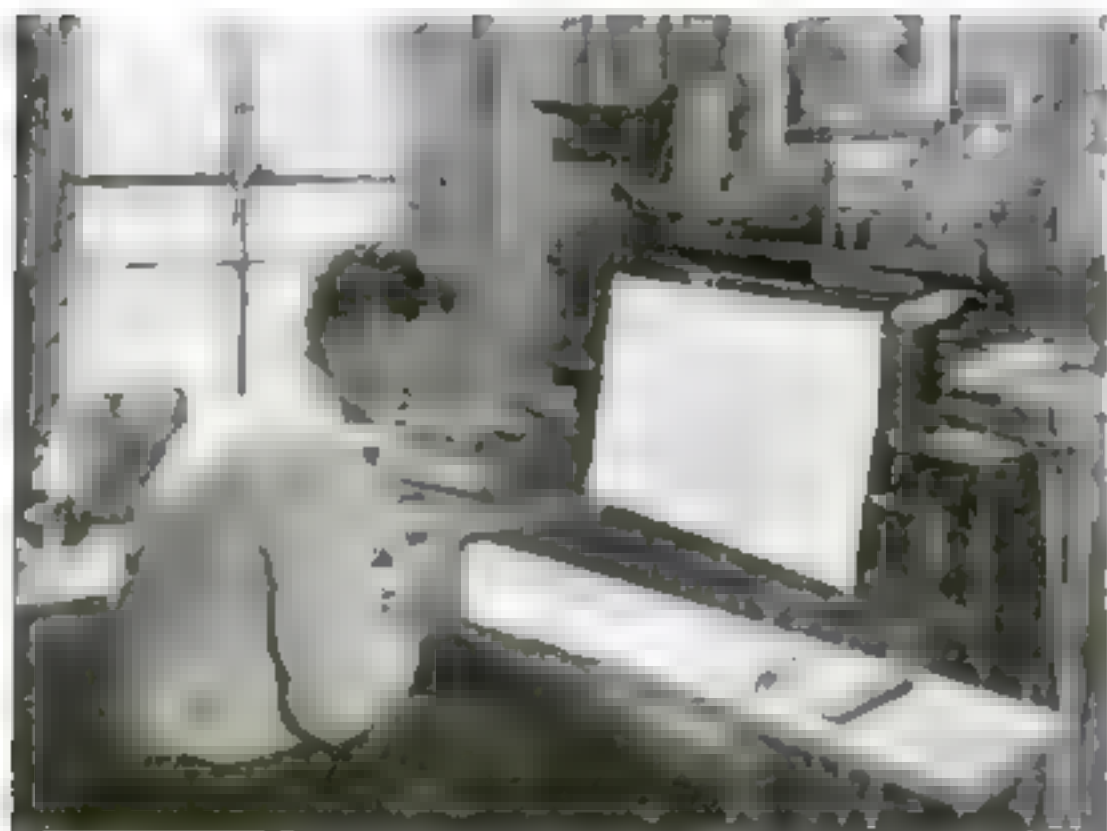
we boarded the boat which had taken us to the guano island, and started to steam toward home. The sun was shining brightly, but suddenly it grew dark and a strange, eerie feeling came over me. All about I could hear a deep humming as if a million swarms of bees had set out to sea.

Imagine all the airplanes in America hopping off from a single field in one mighty squadron, and you will have some conception of the unearthly din of that flock of beating wings.

The mate on the boat smiled at my mystification.

"They're going home," he said.

Mississippi Steamboatin'



Captain McCann uses carbon paper to transfer the breadth lines of the hull on a board. He had the builder's original drawings of the *Buckeye State* to guide him.

ROMANCE has passed from Mississippi steamboatin', but we can preserve a bit of it in our homes by building a model of one of the picturesque speedy and in many ways amazing old stern-wheelers that contributed so large a part to the upbuilding of the Middle West.

Those who live in the valley of the Mississippi River or any of its tributaries will need no encouragement to build this model. Those whose homes are to the east or west and have not fallen under the magic spell of river lore, will find the model worth while because it is unusual and picturesque and because the technique of constructing it involves many new and interesting problems.

The Mississippi steamboat is an entirely American product, evolved for the particular conditions under which it had to work—shallow, treacherous water and practically no docking facilities. In this respect it differs from the eight models of historic ships which preceded it in the *POPULAR SCIENCE MONTHLY* series, for all of them, although intimately associated with American history, were of European build or developed from European designs and therefore chiefly of interest to the sea-minded folk of the Eastern seaboard.

The requirements for a Mississippi boat were—and still are—an extremely shallow hull capable of carrying a heavy load without drawing more than a few feet of water. As the beam had to be narrow, the hulls, though sharp bowed, were given straight sides and flat bottoms. The cantilever principle, as shown in the use of "hog" chains, was employed to prevent the ends from sagging. High speed and the ability to turn quickly were also needed, hence the use of powerful engines, large side or stern paddles, and triple or quadruple rudders.

As there was little space below the

water line, the engines, cabins, and everything had to be piled on deck but this had the further advantage of making the boats light and airy.

In their heyday, before the railroads were built, competition among the boats for passengers was keen. They accordingly were made as attractive as possible, in those days that meant a lot of scroll woodwork, most elaborate saloons and cabins, and gilding and gurgershead.

Because of all these factors, a type of vessel evolved which although lacking the stately grace of the deep-sea sailing ship, had a beauty of its own in fitness for its purpose.

AN EARLY stern-wheeler has been chosen. Some of the side-wheelers, it is true, were the fastest and best known in their time, but their reign was short and the stern-wheeler antedated them and is again the more prevalent.

Much difficulty was experienced in obtaining the exact data. Most of the early vessels were built for individuals, and what plans there were have not been preserved. Finally, however, James Rees and Sons Company, of Pittsburgh, courteously unearthed in their drafting

How to Build a Simplified Model of the Speedy Old Buckeye State, a Stern-Wheel River Packet The One Type of Ship Entirely American



By E. ARMITAGE McCANN
Master Mariner

room the lines of the *Buckeye State*, which they built in 1878. With this information, for which I am grateful, and from other facts obtained here and there, together with numerous suggestions given by that earnest and enthusiastic model maker, Frank L. Coes, of Worcester, Mass., I have been able to build what I believe to be a reasonably accurate steamboat of the period.

The *Buckeye State* (Ohio) was a wooden-hull vessel with a length of 235 ft., depth of hold 8 ft., beam 36 ft., high pressure engines, diameter 18 in., stroke 7 ft. with Rees adjustable or variable cut-off; four boilers, diameter 41 in., length 20 ft.; capacity 900 tons, draft light, 28 in.; speed 15 miles an hour in dead water.

The model has been built to the scale of 1/12 in. to the foot, or 1 in 144. The overall length thus is 19 1/4 in. and the height 7 in. This is a handy size for the average small room, but model makers who have the space would be well advised to make the model twice the size by doubling all measurements, except for those details which obviously could not be kept down to scale on so small a boat. For example, it is almost impossible to keep such parts as the side stanchions and handrails down to exact scale on a 1/12-in. scale model, but it can be done on a 1/6-in. scale model. An alternative method would be to make a model half as large again.

How to mount and display the model will be discussed in detail in the last of this series of articles. In brief, the model may rest flat on a bracket, shelf, or cabinet, or stand on short turned pillars, or be set into imitation water in a scenic display case with a painted

The hull turned upside down to show the shape at the stern. Compare with the drawings on page 124.



"Wooding-up" the *Buckeye State*.

background. The construction of the model will be the same in all cases, except that if it is to be set permanently in "water," the hull from the water line down need not be made.

Little material is required. The hull can be a piece of $\frac{1}{4}$ -in. pine or other wood. I made the decks of holly, because it is beautifully white, is sufficiently tough, and has no obvious grain but any clean, white wood will serve. The remainder of the wood is scraps of mahogany, and some whitewood, poplar, or any other semihard wood. Other materials needed are a sheet of good quality cardboard, such as the best artist's bristol board, some scraps of tin, brass, or copper, a little wire, some small brads and $\frac{1}{2}$ -in. pins, a very small quantity of light blue, black, and white paint, enamel, or lacquer.

YOU will find a complete list of materials on POPULAR SCIENCE MONTHLY Blueprint No. 96. This is one of three blueprints—Nos. 94, 95, and 96—which have been prepared to make your work easier. They can be obtained for 75 cents from the Blueprint Department, and a coupon for your convenience in ordering them appears on page 100. On the blueprints are full size drawings of all the essential parts of the model and all the information you need to lay out the work accurately and quickly.

While it may be possible to construct

a model without full size drawings, I should not attempt it myself and doubt whether any experienced model maker would. Therefore, it is necessary either to prepare your own full size drawings by enlarging the mechanical drawings which will be reproduced in this and following articles—a none-too-easy task even for a skilled draftsman—or make use of the blueprints, which are substantially the same as the drawings I

RIVER PACKETS RACE ONCE MORE

STIRRING accounts and photographs of a race between the steam packets *Betsy Ann* and *Chris Green* on the Ohio River were published in the newspapers recently. The nation-wide interest that was taken in the race was akin to the enthusiasm that has greeted the revival of show boat days and plays—on the stage, in the movies, and, indeed, on the boats themselves. The growing list of stories about Mississippi steamboatin' is another indication of what the old packets meant in the life of the Valley. And if you, too, have in you the love of river lore, you will want to build the *Buckeye State*.

prepared for my own guidance in building the model.

Now let's get to work! On a piece of wood $\frac{3}{4}$ by 8 by $17\frac{1}{2}$ in. draw a line right around the middle. Mark on its upper surface the harpin line shown in the illustration on page 123, this represents the top of the hull. Cut away vertically to this line. On both sides mark the sheer line. The bow end is $\frac{1}{4}$ in. above the bottom of the block, the stern end, a scant $\frac{1}{4}$ in. Connect these points, not with a straight line but with a true curve. This curve should be a scant $\frac{1}{8}$ in. hollow at the center.

SHAVE down to the sheer line. A spokeshave is the handiest tool for this work, but the block can be whittled and sandpapered to shape.

From a piece of cardboard make three templates to the lines given in the body plan (page 124). Shave away the bow until the templates fit at their respective positions shown on the half breadth plan.

The bow is quite sharp at the stem and widens out rapidly until, at 4 in. from the bow, the sides are vertical. From that point aft, only the lower corners are rounded about $\frac{1}{2}$ in. up and across.

The stern is more difficult to describe. It will be noted on page 123 that right aft a rectangular piece is cut out, this is a cut $2\frac{1}{4}$ in. wide and $\frac{3}{4}$ in. deep into the end of the hull. It leaves projecting horns on either side. (Continued on page 123)

Better Ways to Do Woodwork

How to Lay Out, Saw, and Plane Boards and Make Doweled Joints—Hints on Furniture Building and Odd Jobs

By EDWIN M. LOVE



A MOMENT of great anticipation! The home mechanic removes the clamps from his assembled radio cabinet and prepares to give it a last cleaning before applying the paint, varnish, or lacquer. What does his inspection show?

Does he mutter under his breath and reach for the plastic wood, putty, glue and sawdust, or powdered-brick crack filler, or does he smile with pleasure as he finds every joint tight and the broad surface free from marks? Much depends on whether or not he has done his work "decently and in order."

By taking thought, any amateur woodworker can do craftsmanslike work. Probably as many mistakes come through improper laying out as through unskilful handling of tools.

Lumber, as it comes to the mechanic these days, is generally of uniform thickness and often flat enough for cabinet building. Nevertheless, in the order of the work, it should be treated as if the sides were not parallel.

One side, usually the better, should be lightly marked with an "X" to identify it as a face side. It is against this side and only this side that the try-square is held for testing the edges. An edge jointed, planed, straight and square is likewise taken for a working edge, against this the square is held for marking



Setting a line along the inner edge of a steel framing square.

the ends to be sawed off.

The wise amateur avoids a pencil in laying out. He uses a sharp knife or an awl point. A soft pencil makes a line that is easy to see, but there its virtues end, for a saw wobbling from side to side on it may vary as much as $\frac{1}{8}$ in. A hard pencil is better, but a knife point locates a measurement exactly.

When the framing square is used, the marking tool should trace along the inner edge that rests against the wood rather than against the outer edge, which does not touch the surface of the wood and therefore allows the point to vary. If carefully sawed along a well scribed line, the end of the board will be square with the face edge. The other edge may be located either by accurate measurement at the ends—useful especially if it is not to be parallel with the working edge—or by gaging.

Two difficulties beset the man who joints the edge of a board. The plane may scoop out the center, leaving the ends high, or more commonly it may reduce the ends while leaving the center

In the first case, the jointer plane is probably so dull that it chatters at the start, and the user unconsciously confines his efforts to the center, where the plane rides easily. The remedy is to hone the plane iron and take shavings at the ends of the board until the edge is fairly straight, and then to finish with full-length cuts. In the second, the heel of the plane is dropped at the start, and the toe at the end of the stroke, with the re-



How to lift a jointer plane at the end of a stroke to prevent "dubbing" or slightly rounding the corner.

sult that gradually the ends are "dubbed" off. If the plane is lifted badly at the end and carried back, a straight edge is more likely to result. Incidentally, the wear on the plane iron is cut nearly in half.

Accurate measurements depend upon accurate measuring sticks. If the various parts of a cabinet are measured with a square, inaccuracies in reading may cause slight variations in the relative length or width of the mating parts, making their assembly difficult or even impossible.

In simple cabinets, it is better to lay out one part and take from it the corresponding measurements on other parts. For pieces that *(Continued on page 133)*



Laying out a measuring rod for a piece of furniture with the square held vertically.



The shoulder of a tenon can be cut more easily if a notch is first made for starting the saw.



Squaring across the edges of two boards to locate the position for boring dowel holes.

Grace and Color Distinguish This FIREPLACE SPARK SCREEN

Yet It Can Be Made at Trifling Cost and No Great Labor with the Tools Found in Every Home

By BEN WELLWOOD

NOTHING sets off a fireplace better than an artistically designed fireplace screen. High prices are asked for screens that have a decorative, handmade appearance, but the actual cost of the materials in even the best of them is relatively small. The amateur craftsman therefore can make a screen for far less than he can buy one. For example, the screen illustrated cost only \$9.05 for the iron, brass, screening, and hardware.

The screen is 26 in. high and 30 in. long. It laps over the brickwork of the fireplace opening 1 in. on the top and sides. The materials required are 9 ft. 4 in. of $\frac{3}{4}$ -in. band iron and the same amount $\frac{3}{4}$ -in. band brass; 28 in. of No. 16 mesh bronze screening 32 in. wide; 3 doz. brass nails 1 in. long; 1 sheet of galvanized iron 26 by 32 in.; 2 bronzed ornaments and 1 ornamental bronzed handle. The band iron may be obtained at any blacksmith shop, the remainder of the materials at a hardware store.

The first step is shaping the frame. Cut a cardboard or thin wooden template for the corners as shown in Fig. 2. A full size outline of the frame drawn with chalk on the floor will expedite the shaping process. Take the 9 ft. 4 in. length of $\frac{3}{4}$ -in. band iron and mark a point 15 in.

Charming on this fireplace screen is, no special skill in metal work is required to construct it. The silhouette is short iron, bronzed and colored.



from the end. Here form one of the lower corners of the frame and check the bend with a large square. Then place a mark 21 in. from the corner and make a bend for one of the upper corners, using two large monkey wrenches as shown in Fig. 1. Bend the remaining corners so that the frame fits the outline on the floor. The ends will meet in the center at the bottom if the bends have been made accurately.

The inner brass frame is in two sections: the two sides and bottom are in one piece, and the top with the two curved ends is in the other. The $\frac{3}{4}$ -in. brass can be shaped readily by hand.

Hold the brass and iron frames together with C-clamps and use a $\frac{3}{16}$ -in. drill to make a series of holes through them 3 in. from center to center, as in Fig. 3. The screening is inserted between the frames. Tongues of the silhouetted design — to be described later — are clamped with the screening between the frames.

The screen is fastened first at the top and one side of the brass frame. Slip the brass nails through the holes and the wire mesh after cutting off the nails so that they will project $\frac{1}{2}$ in. beyond the frame for riveting. If facilities for riveting are lacking, merely bend over the brass nails and hammer them flat. Next pull the screening through the lower part of the frame and fasten it similarly in place. Little pressure is

necessary; too much may cause the screening to break at the top.

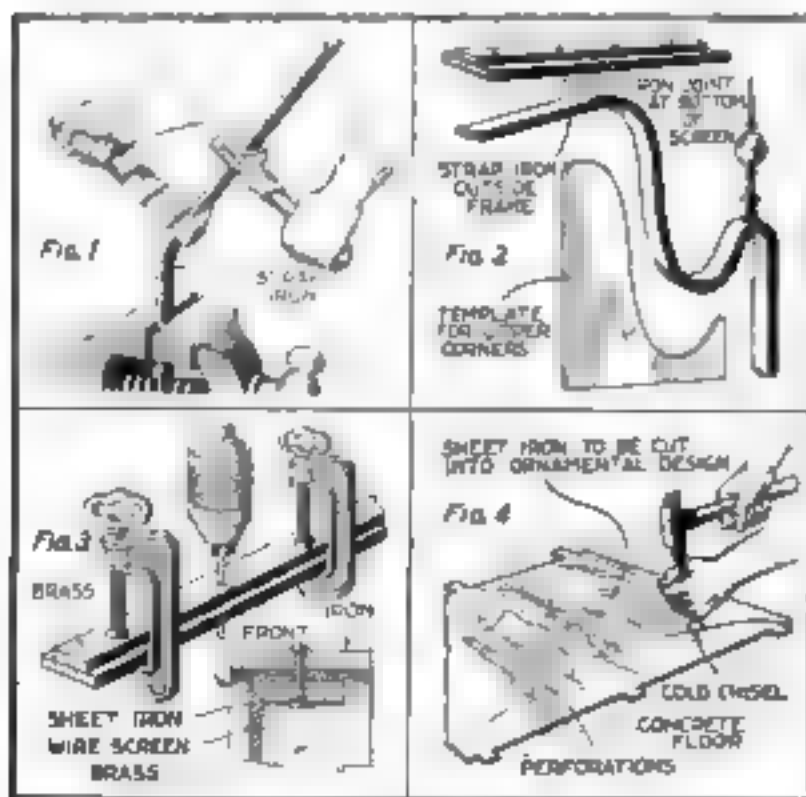
An old brass bedstead may furnish the ornaments, and it is sometimes possible to obtain suitable ornaments from dealers in hardware specialties. However, they are not essential, although they do give a desirable decoracy of line.

NOW that the frame is assembled, all that remains is to make the silhouette design. A full size outline drawing should be pasted on the galvanized iron as shown in Fig. 4. Place the iron on a cement floor or other firm support and perforate the outline with a nail set, the holes being as close together as possible. Then detach the design with a $\frac{1}{4}$ -in. cold chisel. The fact that the outline is irregular or corrugated is no disadvantage.

Attach the design by bending the tongues between the brass and iron frames. If the sheet metal design does not lie flat against the bronze screen, fasten it with a few "stitches" of thin copper wire, twisted at the back of the screen.

A simple way to finish the screen is to apply one coat of red lead and when this is thoroughly dry give it a coat of clear varnish mixed with bronzing powder. While the varnish is still wet it can be stippled or mottled with burnt sienna oil color to produce a two-tone bronze effect. It is somewhat difficult to make paint adhere properly to newly galvanized metal, so the red lead must be brushed on with a good deal of vigor and pressure.

The screen is held in position by driving a piece of $\frac{3}{4}$ in. wide brass between the first course of mortar and the iron lintel of the fireplace and bending it so that it laps over and holds the frame like a spring catch. If legs are desired, they can be shaped from $\frac{3}{4}$ -in. band iron.



Bending strap iron (Fig. 1); ornamental corner (Fig. 2); drilling the frame (Fig. 3); cutting the silhouette with a chisel (Fig. 4).

Auroras Shot from the Sun

Mysteries of Northern Lights Explained—A \$50,000 Search for a Meteorite—Discoveries and New Events in Astronomy

WHAT makes auroras? "The sun!" is the latest answer given by Prof. Carl Störmer, Norwegian astronomer. Like a mighty siege gun bombarding the earth with backshot, every sunspot that crosses the face of Old Sol pelts the earth with a hail of electrified particles. When they strike the earth's atmosphere they flash into the brilliant displays we know as the mysterious northern lights.

Often the colored electric fires of the sky invade temperate regions—about one out of ten a aurora is visible as far south as the middle of the United States. An aurora can cover practically the whole earth at once: the aurora borealis, or northern lights, and the aurora australis, seen by those in the southern hemisphere, may be witnessed simultaneously. Prof. Störmer recently demonstrated by scientific models of the path of particles shot by the sun that these, caught by the earth's magnetism, whirl about our sphere in belts of varying width centered at about sixty degrees north and south latitude—two thirds of the way to the poles. Besides the known fact that most auroras occur here Prof. Störmer has verified his calculations by producing an artificial aurora in his laboratory.

An aurora's seemingly dazzling display is misleading; actually, you could not read a newspaper by its light. Stars have been seen shining through a display. Few auroras are seen when there is a full moon, and none by daylight. An individual auroral streamer that you may see overhead is probably visible to observers

A magnificent auroral curtain sweeping across the sky. Its lower edge is about seventy miles above the earth, while its highest streamers may reach up six hundred miles high.



within about a five-hundred-mile radius.

Experts are now working on the last of the aurora's mysteries—the curious green line seen in its light when analyzed with a spectroscope. Recently Dr. Gunther Cano and Dr. Joseph Kaplan, at Princeton University, have produced brilliant duplicates of the auroral green line and of another red line recently discovered in the aurora's spectrum, using a mixture of oxygen and nitrogen—suggesting that "active nitrogen," present also in explosives and fertilizers, may be the source.

Hunting a Huge Meteorite

AS THIS is written a \$50,000 party of men and machines is digging a hole in Arizona, looking for a fabled meteorite that may contain \$2,000,000 (000) worth of metallic nickel. The heavenly visitor they seek, believed to have buried itself beneath the great Canyon Diablo crater, three quarters of a mile across and 600 feet deep, is thought to be the greatest of a whole tribe of stray missiles that bombard us from the sky.

Probably the largest meteorite of modern times was that seen to crash to earth in a desolate forest of Yenisei, Siberia, in 1908. The heat and shock of it was felt by passengers in a train four hundred miles away. It has not been recovered. The largest meteorite ever found, a fifty-ton monster, is in Bacubirto, Mexico.

Experts say that falling meteorites, as they blaze through the air at twenty or thirty miles an hour, are fused to white heat at their surface by air friction; yet their interiors are extremely frigid—more than four hundred degrees below zero, which is approximately the temperature of outer space. One meteorite, falling on marshy ground in India is said to have instantly frozen fast!

How the Moon Is Measured

AS BIG as a silver dollar" is a romantic but not very satisfactory description of the size of the full moon. In order to compare heavenly objects and distances more accurately, astronomers use an ingenious and simple system of measurement.

The entire semicircle from one horizon, across the sky to the opposite one—the summer path of sun as it sweeps across the heavens—is divided into 180 "degrees." These may be measured off in any direction, and indicate, not an actual distance, but the angle through which a telescope is swung in crossing from one side of a celestial body to the other.

Our moon, for example, when full is said to have an "apparent diameter" of about half a degree.

Two Solar Eclipses Coming

ONE of the greatest astronomical spectacles of the near future will occur in September, 1922, when New York and New England will witness a total eclipse of the sun. Under favorable weather conditions, it will be seen by as many persons as that of January, 1923. The International Astronomical Union, whose members from all over the world meet every three years, will hold its 1922 gathering in the United States in order to be present at the event.

The path of the eclipse, as calculated by L. J. Comrie, British astronomer, will come down from Canada and cross New England in a bell-shaped area about 100 miles wide. The southwest edge will graze Montreal and Salem, Mass. Totality when the sun is completely hidden, will occur about 3:30 p. m., and will last one minute and forty seconds.

Western parts of the United States will see an unusual astronomical event on April 26, 1930—a "central" eclipse of the sun. Along a path through California, Nevada, and Idaho the eclipse will be total, but northern Montana will see an "annular" eclipse, in which the moon's disk leaves a ring—(Continued on page 59)



This brilliant display of aurora borealis was photographed in Norway by Prof. Carl Störmer. He believes auroras are caused by bombardments of electrified particles from the sun.

New Triumphs over Friction

Magic Oil Films Let Industry's Engines Roar at Amazing Speeds

By GEORGE LEE DOWD, JR.

MAJESTIC in its towering rigidity, the largest dock gate in the world swings open to admit an ocean liner. It is the most impressive feature of the new \$35,000,000 Gladstone Dock, pride of Liverpool, England. Five hundred tons of steel, propelled by unseen machinery, recedes silently and smoothly on massive bearings before the incoming vessel.

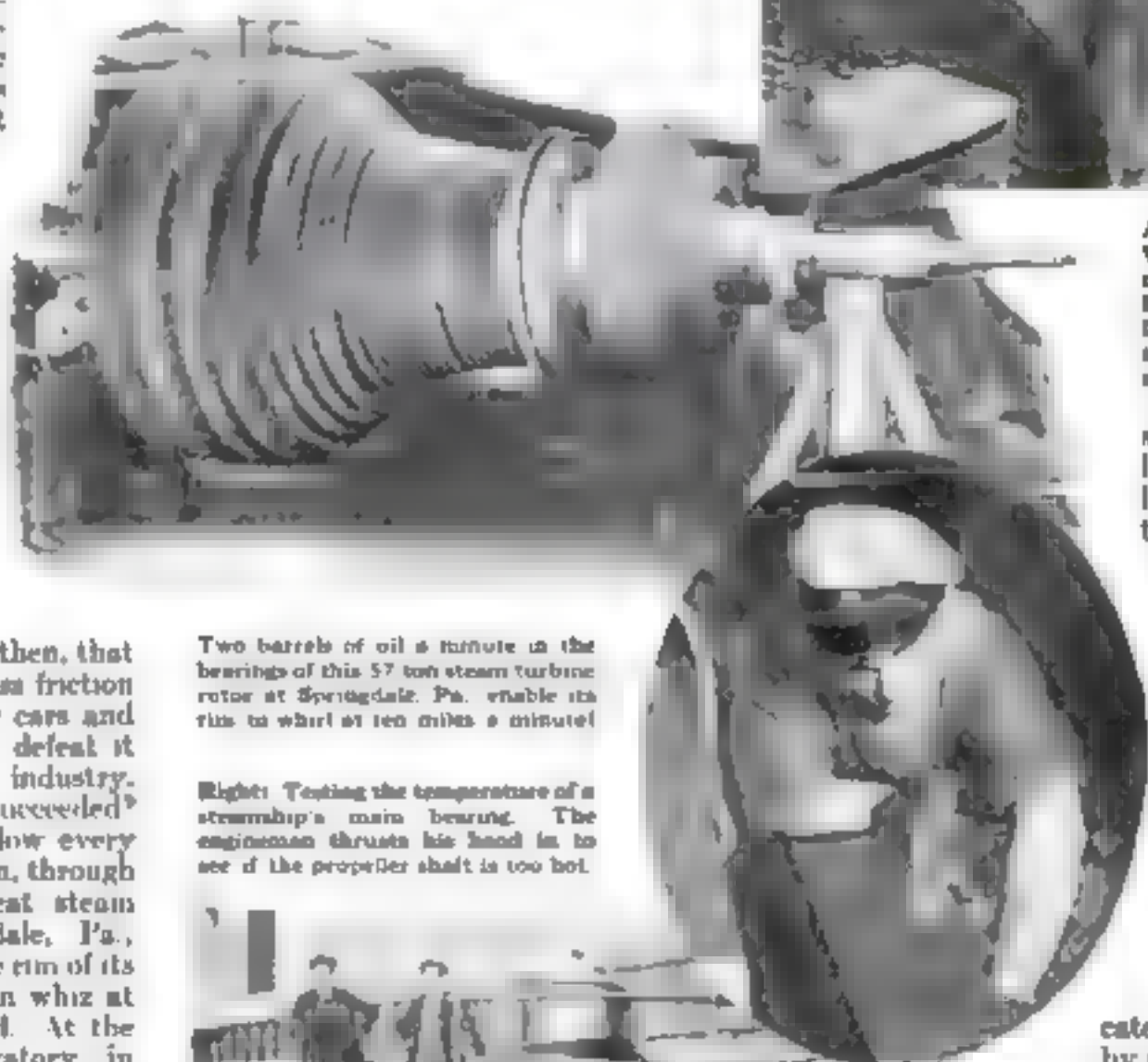
That it should be possible to swing a veritable skyscraper of metal is a miracle of modern engineering. It is one evidence of modern progress in conquering friction—the arch enemy of all moving things, the same grinding force that hurls railroad cars with "hot boxes" and scorches meteorites to incandescence.

What is this strange force? Other forces, magnetism and gravity, for instance, are servants of man, driving his machines. But friction is a parasite. It preys upon the driving forces and wastes them. The second that a wheel or shaft starts turning, up leaps friction to stop it. No wonder, then, that engineers seek to harness friction in the brakes of motor cars and railway trains—and to defeat it wherever it hampers industry. How well have they succeeded?

Two barrels of oil flow every minute, as this is written, through the bearings of a great steam turbine in a Springdale, Pa., power house, so that the rim of its fifty-seven-ton rotor can whiz at ten-mir-a-minute speed. At the Mount Wilson Observatory, in California, the world's largest telescope and its 100-ton mount swing without a jar upon the practically frictionless surface of a tank of mercury. And in each of the 70,000-horsepower hydroelectric units at Niagara Falls, largest of their kind, a single "thrust bearing" supports upon a film of oil the 1,100,000-pound weight of a giant generator armature and water wheel—a weight that four of the world's most powerful locomotives could barely lift—and does it so smoothly that the

whole mighty shaft, under the impact of tons of water, can whirl more than a hundred times a minute without danger of grinding its support to bits.

Come with me into the engine room of a great steamship. In the grip of the main bearing, the turning propeller shaft transmits the impulses of the engine to the screw into a hole in the side of the great bearing, an engineer thrusts his hand, feeling the



Two barrels of oil a minute in the bearings of this 57-ton steam turbine rotor at Springdale, Pa., enable its rim to whirl at ten miles a minute!

Right: Testing the temperature of a steamship's main bearing. The engineer thrusts his hand in to see if the propeller shaft is too hot.



This single bell-shaped bearing of a Niagara Falls hydroelectric unit supports a million-pound weight, whirling 100 times a minute.



A victory over friction. Weighing 140 tons, this mammoth dock gate at the Royal Victoria Docks, London, swings smoothly and evenly on the bearing shown at the extreme left.

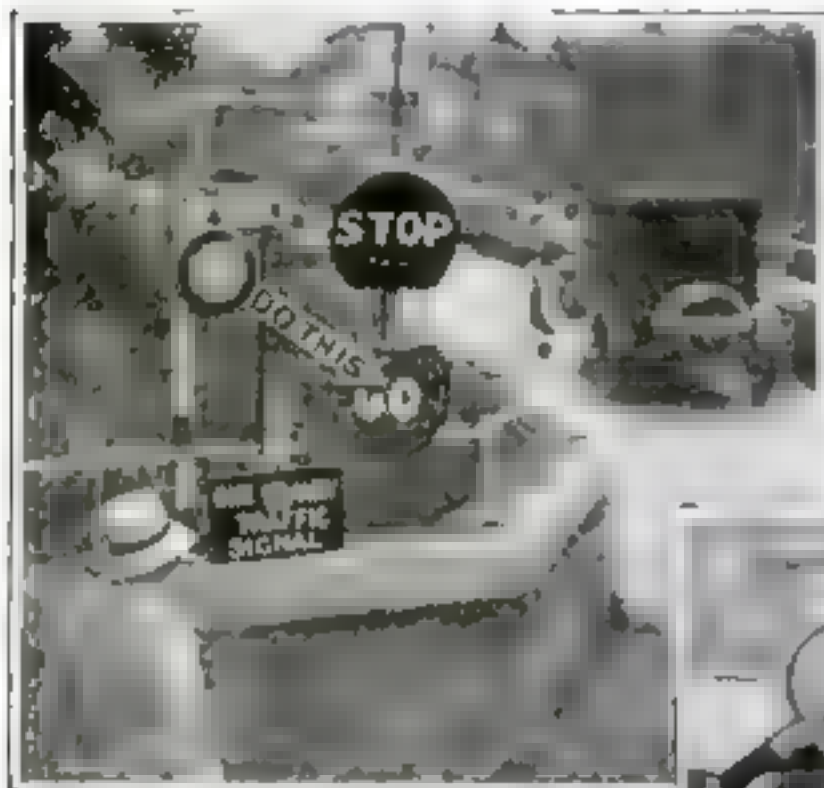
shaft to see if it is too hot. The oil is getting low, and he replenishes the cups from which it drips upon the shaft to form a protecting coat.

Probably the mightiest bearings are those of tropical sugar mills, which must stand the grinding of huge rollers that crush the sap out of matted cane. Great journals of bronze are these, and oil that lubricates them is pumped in by powerful steam-driven compressors.

So, throughout industry, the fight against friction is never-ending. Sometimes a whirling ring splashes oil over the bearing, elsewhere, wicks drip it on. Graphite, called the world's greatest solid lubricant, may take the place of oil when heavy metal surfaces grind together, as in automobile spring leaves. Ways have been found, too, to force lead and copper into porous graphite, forming an alloy of

(Continued on page 167)

Invents One-Man Control of Bridge Traffic



Left: The ingenious signal invented for one-man control of one-way traffic across a narrow bridge in Hampshire, England. A lever moves the indicator at each end of the bridge. Thus when it reads "go" at one end, it reads "stop" at the other.

Below: A view of the control box showing the officer with his hand on the lever which moves the signal indicators at each end of the bridge. The signal reads "go" at one end, "stop" at the other.



TRAFFIC from both ends of a narrow bridge wide enough for only one car, in Hampshire, England, is controlled by one man through an invention perfected by P. D. Hachford, a traffic guide of the Royal Automobile Club.

The operator sits in a raised tower at one end of the bridge, and with a lever swings an indicator at the opposite end alternately to "go" and "stop."

When the indicator at one end of the bridge allows the cars to proceed, the operator at the other end signals "stop." Thus he can control traffic one way at a time by a single movement. This does away with the necessity of having a man stationed at each end of the structure.

Longer Life for Heaters

LONGER life and higher efficiency for electric toasters, irons, and heaters of all kinds is promised, according to the Westinghouse Electric and Manufacturing Company, by a new insulating compound just developed in its laboratories. Curiously, the silvery metal magnesium, a good conductor of electricity instead of an insulator, is used in the manufacture of the substance.

The new insulator replaces mica or asbestos to keep stray electric currents from leaping across gaps between heating coils. It is made by winding ribbon of metallic magnesium around an electric wire and inserting the wrapped wire in a tube, where both are given a bath of steam at 450 pounds pressure. The result is a hard, white material, an oxide of magnesium, that can be formed in any desired shape.

Rubber Pads Silence Trains

SO SUCCESSFUL have rubber pads proved as shock-absorbers and silencers for railroad trains, after a test on one rail length of a Federated Malay States railroad, that they are to be tried on longer stretches of track. The rubber, which is made by special process, was found to deaden the sound of the clinking of rails within the coaches, and to absorb practically all vibration.

Submarine, Stuck in Mud, Saved by Sister Ship

SOMETHING new in submarine rescue occurred in Italian waters the other day, when the undersea craft *N-34*, commanded by Lieut. Perrucchetti, became mired in mud at the sea bottom off Rome. Captain Perrucchetti, brother of the *N-34* commander, was standing by with his new 2,000-ton submersible *Ballilla*, when he learned by undersea signal of the sister ship's fate.

Without waiting for orders, the latter dove his ship to the spot where the *N-34* lay stuck in the ooze. Gently ramming it, he succeeded in nosing it out of the mud and it rose to the surface. The *Ballilla* itself became mired, but freed itself by its own power. For failure to report the accident first to higher authorities, and going to the rescue himself instead, Capt. Perrucchetti was ordered to prison, but later was freed and honored for his feat.

Television to Field Baton

TELEVISION soon will play a part in solving a puzzling problem for the orchestra leader, according to Fritz Reiner, conductor of the Cincinnati Symphony Orchestra. A symphony to be presented calls, at one point, not only for a full orchestra on the stage, but also for a second orchestra hidden from view in back of the stage to provide faint strains of music as from a distance.

During a concert, Conductor Reiner, leading the main orchestra, says that he will transmit his image by television to the concealed musicians so that they, too, can keep time with his moving baton.

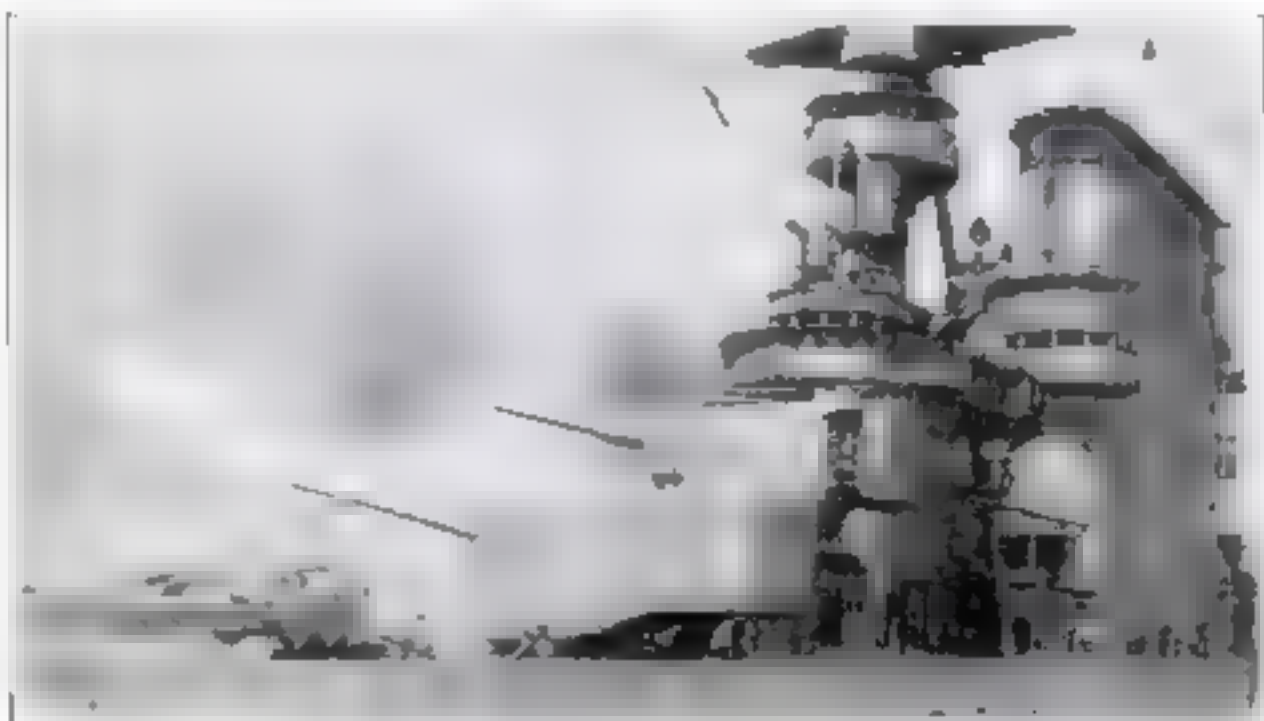
U. S. Aircraft Carrier Tests Her Big Guns

A CRASHING salvo from the U.S.S. *Lexington*'s new eight-inch guns was the recent climax of four years' effort by ordnance experts of the Navy to perfect the huge armament for installation on aircraft carriers.

This photograph, first ever made of the *Lexington*'s big guns and turrets in action, vividly shows how a carrier, "eyes of the Navy" through its covey of observation planes, may become a formidable battle-

ship as well. It was taken during battle practice off San Clemente Island on the Pacific coast.

The *Lexington*, with its twin aircraft carrier, the *Saratoga*, are the largest ships ever built in the United States. Both are all-electric in operation and can carry a fleet of more than eighty planes. The landing field provided by the deck of this mother ship for aerial fighters is nearly nine hundred feet in length.



The U. S. aircraft carrier *Lexington* firing a salvo from her new armament of eight-inch guns.

Tests Reveal Some Common Errors in Knowledge

DO YOU know why winter is colder than summer? How deep scuttled ships sink in the sea? Why air in a close room gets bad? If you do, you cannot be caught in pitfalls of ignorance that trap many a man of more than average education, as disclosed by a recent New York survey of college graduates and others presumably well informed.

The first question was the one that caught the most people. More than four fifths of those questioned declared that winter is colder than summer because the sun is then farther away. But they were wrong. The sun's distance has nothing to do with the question (actually it happens to be nearer in winter); the real reason lies in the earth's changing slant which brings the sun directly overhead in summer, and lower in the sky in winter.

A surprisingly common error was the notion that sunken ships do not go to the bottom, but float at some midway level. The reason heavy objects sink is because they are denser than water, and they sink clear to the bottom of the water because water's density remains virtually unchanged despite the enormous pressures encountered at great depths.

Air in a close room gets bad, not because of carbon dioxide gas exhaled by its occupants, as many supposed, but because of the gradual exhaustion of the oxygen contained in the air.

Other common misbeliefs were that a tree always shows one growth ring for each year of its life, and that Hannibal made a road across the Alps by dissolving the rocks with vinegar.

Billion for Army Aviation

SINCE its \$30,000 grant to Samuel Pierpont Langley to develop a flying machine, on which preliminary experiments were made in 1890, up to the present day, the U. S. Army has spent more than \$1,000,000,000 on aviation, according to figures just announced by the aeronautics branch of the Department of Commerce.

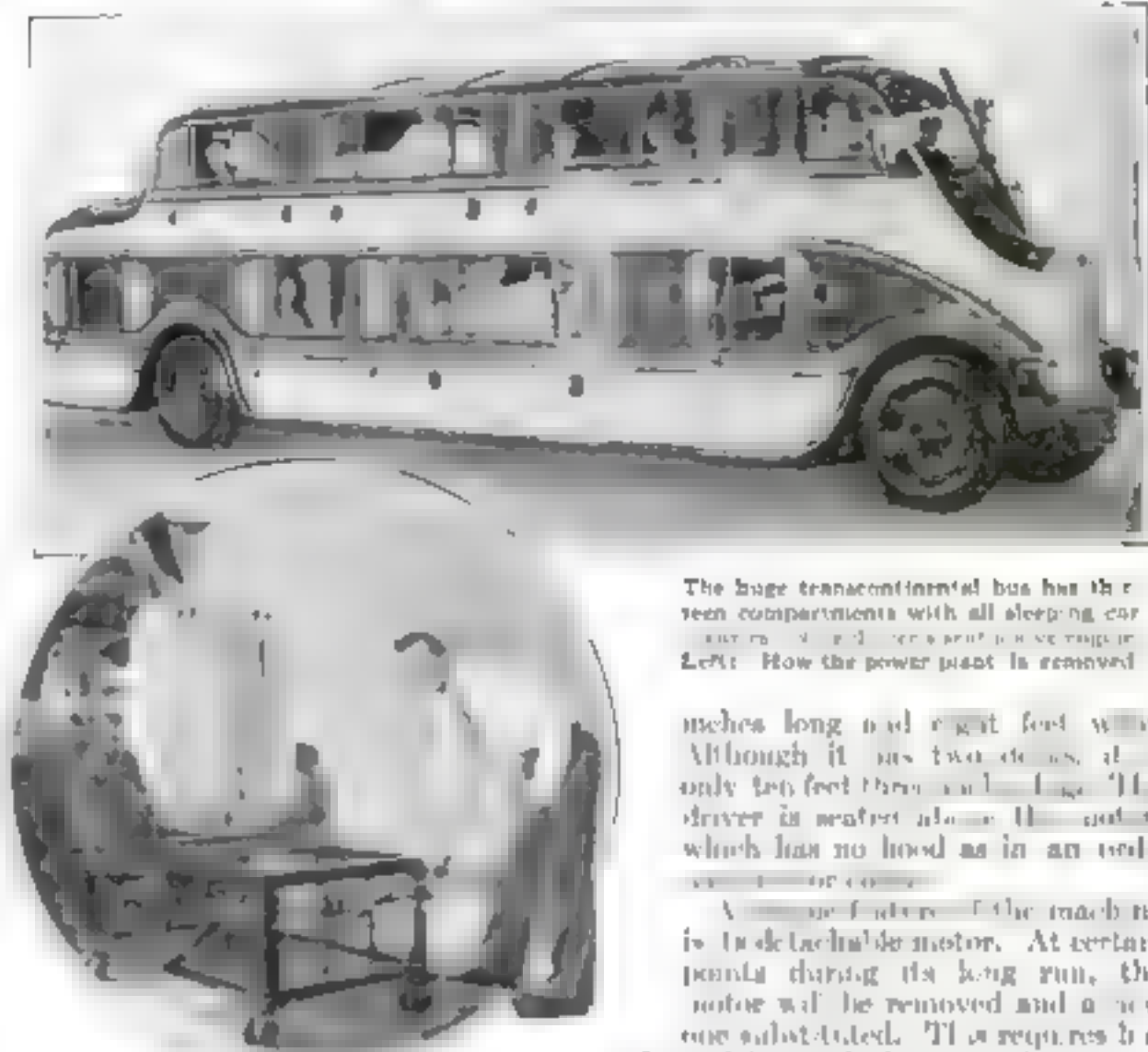
Folding Cover Protects Rumble Seat Riders

NO LONGER need the occupants of an automobile rumble seat be at the mercy of the weather. A new cover in the form of a canvas hood unfolds at a moment's notice from a container on the



The canvas top is placed over the rumble seat. It is unfolded from a container at the rear and is fastened in position with spring clips.

Twenty-Six Sleep in New Cross-Country Bus



The huge transcontinental bus has thirteen compartments with all sleeping compartments. Motor coach Pollman is shown in right. Left: How the power plant is removed.

A DOUBLE-DECK Pollman of the highway, providing berths for twenty-six people and hot meals during the long journey, recently was completed for service between Los Angeles, Calif., and Philadelphia, Pa. Each of its thirteen compartments has, among other conveniences, a wash basin with running water and a built-in thermos bottle to add to the comfort of the passengers. At the back of the coach is a lavatory, and in front, beside the driver, is an observation seat.

The body of the huge, all-metal, seven-ton coach is made of duralumin to cut down weight, and it is streamlined to increase speed. It is thirty-four feet four

inches long and eight feet wide. Although it has two decks, it is only ten feet three inches high. The driver is seated alone in the motor, which has no hood as in an ordinary motor coach.

A unique feature of the machine is its detachable motor. At certain points during its long run, the motor will be removed and a new one substituted. This requires but a short delay and eliminates long stops for overhauling during the trip.

Besides the driver, a porter and a chef are included in the crew. The only stops required will be those to service the machine. Thus it is expected that hours will be cut from the present motor-coach time across the continent.

Calls Atom Power a Dream

FROM the sun must come the energy that will run the world for the next billion years, as it has in the past. Dr. R. A. Millikan, famous for his researches on star-born "cosmic rays," recently declared. Harnessing the energy supposed to reside within atoms of matter, Dr. Millikan said, is "a childish Utopian dream," and the idea that chemists might wreck the world by unlocking it "a foolish bug-a-boo."

His studies of the extraordinarily penetrating rays he has detected coming from the stars, described in the July *POPULAR SCIENCE MONTHLY*, have convinced him, he says, that the world has existed for a billion years already, with every prospect of man's continued existence for another billion years.

The Rotor Ship Passes

REMOVAL of curious wind towers that drove the steamship *Boden-Boden*, and substitution of a prosaic Diesel engine, has just marked the passing of the Flettner rotors as a commercial test.

Anton Flettner's idea was to utilize a part of the wind's unbounded energy to drive ships; in short, to use spinning towers as sails to drive vessels. Craft actually run, propelled by the rotors. In the long run, however, it was found that these apparently could not commercially rival more conventional forms of power.

back of the car. Its side and back curtains contain windows, the whole is made in one piece and is fastened with spring clips. Adequate ventilation is obtained by removing the rear curtain on a roadster top, or opening the rear window on a coupé model. Or the sides of the curtain may be folded back if desired. In a test it was raised and secured without difficulty in a car moving at a speed of fifty miles an hour.

The rumble seat cover is manufactured of various types and colors of fabrics, to harmonize with the top material of the automobile on which it is to be installed.

Hundred-Foot Fire Ladder Raised by Motors

MILWAUKEE firemen need no airplanes these days to get the thrills of sky riding. They have just come into possession of a new telescoping ladder, imported from Germany, which rises to a height of 100 feet in thirty seconds. Raised by gasoline motors, it is believed to be the tallest ladder of its kind.

In a recent public demonstration, one of the firemen tested the ladder for himself by perching on the swaying tip, high above the street, and waving down to the assembled spectators.

Build Highest Earth Dam

A RESERVOIR which will add twenty-two billion gallons of pure water to the supply of Springfield, Mass., will result from the construction of the world's highest earth dam, forming a giant plug in a gorge of the Little River at Cobble Mountain, in the southwestern part of Massachusetts.

The new dam will rise 245 feet above the bed of the stream, and will top by thirteen feet the next highest structure of the kind, the Tieton Dam, in Washington. It will be fifty feet thick at the top and 1,505 feet thick at the base. Into the construction will go 1,800,000 cubic yards of material. The core will be of clay, with sand, gravel, and boulders dumped against it to form the main bulk.

The water it will hold back is expected to cover 1,120 acres.

An Icy Stream in the Sea

A CURRENT of icy water sweeping down the Atlantic with an average width of 110 miles—greater than the distance between New York and Philadelphia—that is the Labrador current as revealed by surveys made by the U. S. Coast Guard Oceanographic Expedition.

Model City Gives a Lesson in Safety

COMPLETE even to "hot dog" stands and traffic policemen, a remarkable model of the city of Detroit has been on display this year in towns throughout the state of Michigan. Its purpose is to teach the lessons of safe driving graphically and entertainingly.

The model, twenty feet long, con-



Raising the 100-foot fire ladder in a public test at Milwaukee. Note the fireman on the tiptop.

The expedition sailed from Sidney, Nova Scotia, July 16, in the Government vessel *Marion* to cruise between Greenland and Labrador to study icebergs. The nearness of the Labrador current to warm currents from the tropics is said to account for the frequent fogs over the Newfoundland Banks. One theory for the existence of ocean currents is that winds, blowing in the same direction year after year, communicate motion, through friction, to the water below.

structed by a New York firm of scenic artists, shows factories in operation, automobiles scurrying through the streets, and boats plying the Detroit River. Miniature street traffic signals are shown in operation, and realistic automobile "smash-ups" show how accidents result from violations of traffic regulations.



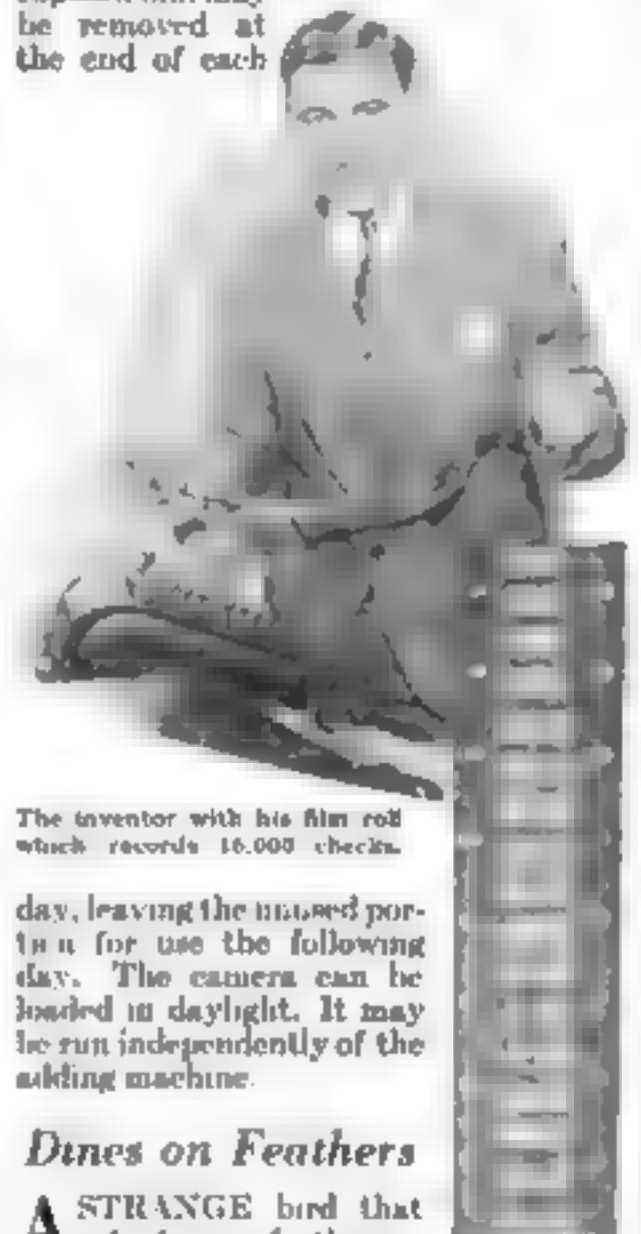
The remarkable scale model of the city of Detroit, twenty feet long, designed to teach lessons of safety in traffic. Even airplanes are seen winging their way above the skyline of the miniature city.

Banker Invents a Camera to Record Checks

TO PROTECT banks and depositors, George L. McCarthy, a former banker of New York City, has invented a new camera which photographs automatically every check cashed or deposited. The instrument can be adapted to any standard adding machine, making a photographic record of every check as it is listed. It carries a roll of film 200 feet long, sufficient to photograph sixteen thousand checks.

The file number of each check is included in the picture and thus the location of any particular check at a later time is made easier.

If desired, the machine will take two photographs of each check, the pictures being made on different rolls of film. The exposed film may be removed at the end of each



The inventor with his film roll which records 16,000 checks.

day, leaving the unused portion for use the following day. The camera can be loaded in daylight. It may be run independently of the adding machine.

Dines on Feathers

A STRANGE bird that eats its own feathers is one of 188 specimens living in Porto Rico, reported recently by Dr. Alexander Wetmore, Assistant Secretary of the Smithsonian Institution. It is the Antidean grebe, a common bird of the island.

Every specimen examined by Dr. Wetmore had masses of feathers in its stomach. They had been plucked and swallowed and apparently digested.

A Huge Dynamite Blast

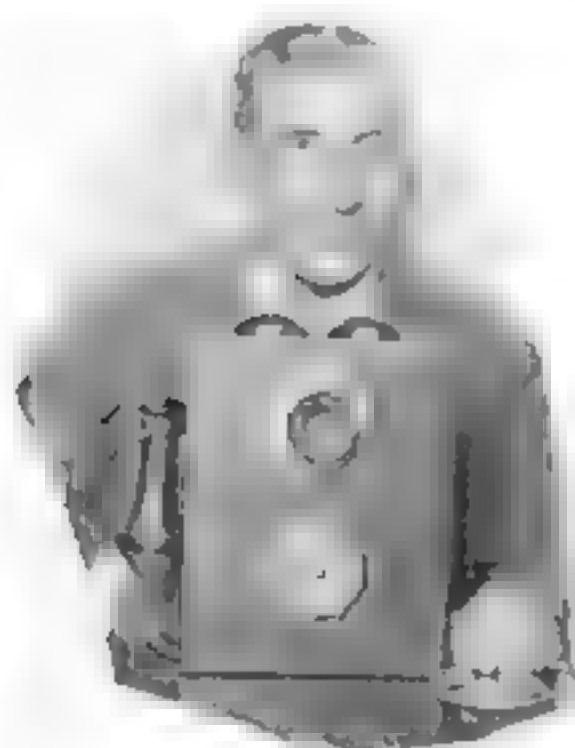
THE explosion of one hundred thousand pounds of dynamite, the biggest blast ever set off in the Pennsylvania coal fields, recently loosened more than 200,000 cubic yards of earth near Hazleton, Pa. It enabled steam shovels to remove the material above a rich vein of coal.

Although the tremendous explosion occurred within three miles of the town, it caused no damage nor injury.

"Phone Box" Takes Movies of Bank Robbers

AN AUTOMATIC, invisible, and silent moving picture camera, housed within an innocent-looking telephone case, is designed to be the undoing of hold-up men. Its inventor, John E. Seehold, of Los Angeles, Calif., is shown below with the new apparatus. In a recent demonstration before a group of bankers, it obtained clear movies of people in a bank who were unaware of its presence.

Sixteen feet of film is carried and the camera can be focused for any distance up to eighty-five feet. The inventor proposes to install the device in banks, where it can be tripped off during a hold-up to give a picture of the criminal and his movements and other characteristics which will aid in his detection.



Huge Scale Sets Standard

A RAILROAD scale, so large it will weigh a 120,000-pound box car and so sensitive it will show the change in weight if a sparrow alights on the car, has been built for the Chicago Belt Line by the U. S. Bureau of Standards. It will record down to one tenth of a pound.

The purpose of the master scale is to standardize heavy weighing in the United States. Other railroads will send test cars to be weighed on the master scale. The cars will be reweighed on their own scales and the results compared. Thus a common standard will govern the 1,200 scales now in use on railroads.

Army Pigeons to Whistle

WHISTLES will be tied to the tails of U. S. Army carrier pigeons to protect them from hawks as a result of experiments at the Signal School, Fort Monmouth, N. J.

Made of featherweight bamboo, the whistles emit a shrill note as the wind passes through them. They resemble those used in the Chinese sport of releasing flocks of pigeons with whistles of different pitches.

The Signal Corps maintains sixteen lofts of carrier pigeons. During the war, the combatants used more than 500,000 of the birds to carry messages.



New Traffic Lights Allow a Three-Mile Run

WHEN this unit in a new traffic signal system installed on Ocean Avenue, Brooklyn, N. Y., says "go," you can run for three miles through city traffic without having the lights turn against you. This is made possible by an electrical control system of synchronizing twenty-one signals so that if a driver maintains an even pace of twenty-two miles an hour, he will never encounter a red stop light. If he drives faster or slower, he will be held up. The new system eliminates forty-two traffic officers.

Model Locomotive Hauls Real Passengers

A MODEL steam locomotive which can pull its engineer, conductor and three or four adult passengers along its miniature tracks has been perfected by a young machinist in Vienna, Austria. Its maker claims it is the smallest loco-

Thousand-Ton Bridge Moved Eleven Miles on Boats

A THOUSAND-TON, three-section bridge recently was moved down the Weser River, in Germany, from its position near Bremen to a point eleven miles away, where it was re-erected.

Each section, 100 feet long, was mounted on two barges, which had been lowered with water ballast until they were able to move under the span. Then the water was pumped from them and they rose, lifting the section from its piers.

Two tugs towed the barges while a third at the rear held them from running the banks on the turns.

The Three Riskiest Jobs

THE three most hazardous jobs in America are those of the steel worker, the railroad yard worker, and the miner, reports the Bureau of Labor Statistics. Other hazardous occupations are glass blowing, slaughtering, and meat packing, and work in lumber planing mills.

During the last year the number of accidents were reduced in almost every industry. However, one worker in sixteen suffered injury, losing an average time of seventy-one days. For every fatal accident there were 153 minor ones. The total time lost during the year due to accidents was more than 10,000 years.

Canada Saving the Bison

CANADA now has more than 13,000 bison on government reservations. The largest herd, about 6,000, is located at Wood Buffalo Park, near Fort Smith, Northwest Territories. The second largest is at Wainwright, Alberta. It grew from four calves adopted by a half-breed, named Michael Pablo, after a slaughter of the animals in Montana. In 1907 he sold the herd, which had increased to 700, to the Canadian government.



A sight-seeing trip on a model railway. This little steam locomotive, built by an Austrian machinist, is so powerful that it can haul a load of nearly a ton. It travels at the speed of eight miles an hour.



Schoolboys Build World's Biggest Kite

WHAT is said to be the largest single-surface kite in the world recently was made by small boys in a military academy in Los Angeles, and successfully flown. Five of the youngsters, ranging in age from twelve to sixteen, built the kite. But it took two dozen of them to hold it

down once they got it up into the air.

The monster kite can lift a full grown man. It measures more than thirty feet from tip to tip.

New High-Pressure Boiler

STEAM at the terrific pressure of 3,373 pounds to the square inch—four or five times as much as the highest steam pressure commonly used in factories—is produced in a new power plant at Charlottenburg, Germany. It is the first large-scale embodiment of the plans conceived by a British engineer named Benson.

High octagonal towers standing in the open air serve as boilers, and their hollow interiors are lined with water tubes where the steam is generated. Coal dust, fed by machinery, burns to give an unprecedentedly hot fire, while the air that fans it is preheated to a scorching temperature of 700 degrees F. before it enters.

"Fighting Jaw" Exploded

THE belief that a protruding jaw indicates pugnacity is scientifically false, according to Dr. Fred Fletcher, American dental expert. "The man with a squirrel-like jaw", he says, "may be just as timid as one with a jaw like a bulldog."

Ocean Waterspouts Are Not Salty, Experts Find

WHERE does the water in a waterspout come from? Meteorologists say the old idea that it is sucked up from the sea is wrong. Over bodies of salt water, the water in these spectacular whirlwinds has been found to be fresh. It is believed that the condensed vapor of the atmosphere through which the whirling vortex moves supplies this.

Waterspouts take two forms. One has a funnel-shaped vortex. The other, illustrated in the photograph below, taken at sea, is known as the dumb-bell type. It has a long, thin tube, whirling at tremendous speed and spreading wider at each end. Spouts of this type have been known to reach nearly four thousand feet into the air.



A giant waterspout over the sea. The whirl contains fresh water, condensed from the air.

Fish and Wood Run Motors

FISH oils, wood tar, and other similar products other than crude oil supply one third of all the "gasoline" used in the world today, according to a recent statement of Dr. Gustav Egloff, of Chicago, research director of a large oil company.

The building at the right, surmounted by the airport control tower, is a factory where light planes are built.



The world's first two-story airplane hangars at the Littorio Airport, Rome, Italy. Planes climb the inclined runway in the foreground to reach the sheds.

More U. S. Fire Tests Set Standards for Safes

SPECTACULAR fire tests to determine the flame resisting qualities of office safes are being continued by the U. S. Bureau of Standards, at Washington, D. C. A few weeks ago, as told in a recent issue of *POPULAR SCIENCE MONTHLY*, experts of the Bureau set fire to two condemned buildings in which they had placed three dozen safes and filing cabinets. All were subjected to terrific temperatures, as high as 3,300 degrees F.

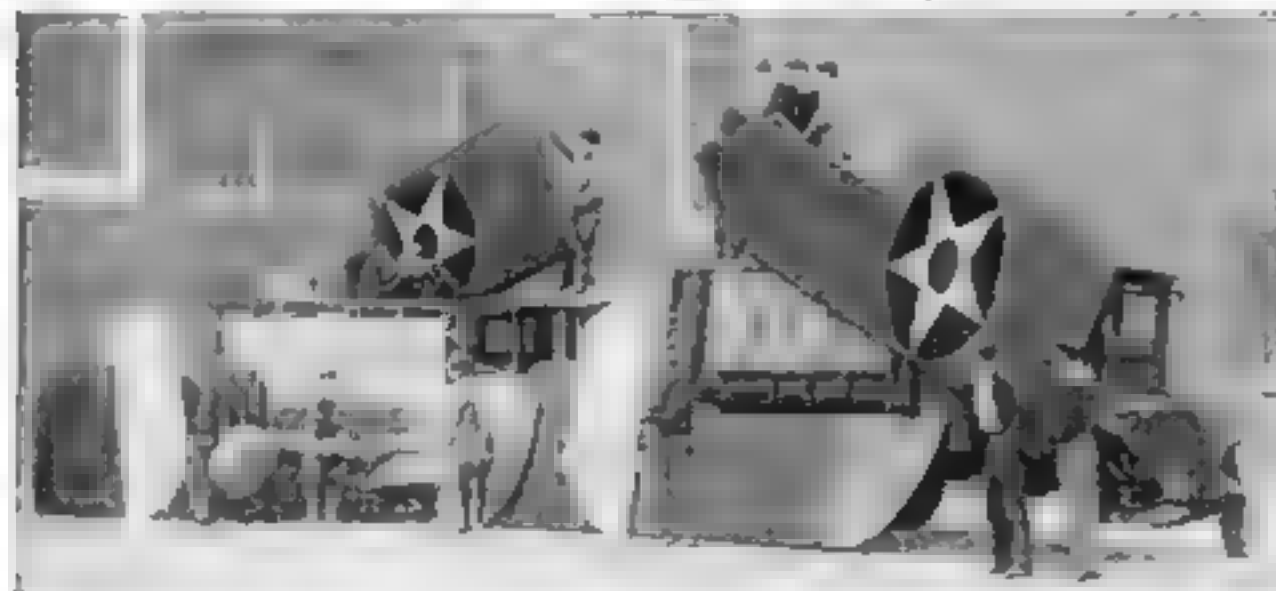
In more recent experiments, the Bureau uses a special heating chamber. All safes accepted for Government use must pass a threefold ordeal, consisting of half an hour of intense heat, followed by a thirty-foot drop upon a hard surface, and finally another half hour of heat.



N. D. Mitchell, of the U. S. Bureau of Standards, placing a safe in the heat test chamber

High School Boys Assemble Their Own Airplane

STUDENTS of the North Attleboro, Mass., High School have just assembled their own De Havilland plane as the first step in a new course in aviation. The Liberty-motored machine will be used for ground instruction only; pupils will "taxi" it across the ground and take it apart and reassemble it.



Parts of the De Havilland plane arrive on motor trucks at the high school, to be assembled by students.



Rockets Drive Model Cars and Planes

MODEL automobiles and airplanes, propelled by little rockets, form the latest toy craze in Germany. In this picture, a group of German children are watching one of the toy rocket cars get away for a flying start.

It is patterned after the famous Opel machine, described in a previous issue

of *POPULAR SCIENCE MONTHLY*, which recently attained a speed of 150 miles an hour on rails, without a passenger, before it leaped from the track and was blown to bits by the exploding rockets.

Ants Help Trace Ore Veins

NOW the humble ant comes to the aid of the prospector. How geologists may well pause in their surveying to test ant hills for desired minerals is described in a remarkable report of W. D. Johnston, Jr., of the U. S. Geological Survey, who tells of a recent attempt to map a valuable vein containing iron and manganese ore in the Little Florida Mountains near Deming, New Mexico.

Several test pits had disclosed the vein, but its course lay concealed. As a last resort Johnston examined ant hills in the vicinity and tested the sand of which they were built. One hill proved to contain as much as twenty-two percent of the desired ores—and beneath it lay the hidden vein!

No More "Sea Serpents"

RECENT reports of a strange sea monster washed ashore on a San Salvador beach, said to suggest the possibility that it was a survivor of prehistoric reptiles known as ichthyosaurs, are discounted by Dr. J. W. Gidley, paleontologist of the Smithsonian Institution. A native hunter, he pointed out, might conceivably mistake for such a monster the partially destroyed remains of a dead porpoise or killer whale which had strayed into these waters.

Modern ships have done much to destroy sea serpent fables, says another Smithsonian scientist, Austin H. Clark. Without the imagination-extending stimulus of a hazardous voyage in a tiny vessel, the sea passenger of today rarely reports such an apparition. Such "sea serpents" as are reported today in good faith, Clark declares, are undoubtedly giant squids or other well-known marine creatures. The squid, often fifty feet long and a foot thick, has branching arms that might easily be taken for sea snakes.

To Make Your Home Complete

A Baker's Dozen of the New Ideas Which Turn Drudgery into Pleasure and Add a Bit to Your Comfort



So, at last, shoes need no longer be crowded on the floor or in the closet. They can be kept in their own place, and you can find them when you need them. Easy to hang, easy to use, and easy to clean.



The implement for peeling eggs is a small, simple, and efficient device. It is made of a piece of wire, bent into a shape that fits the hand and the egg. It is used by holding the egg in one hand and the implement in the other, and peeling the egg by moving the implement back and forth over the egg.



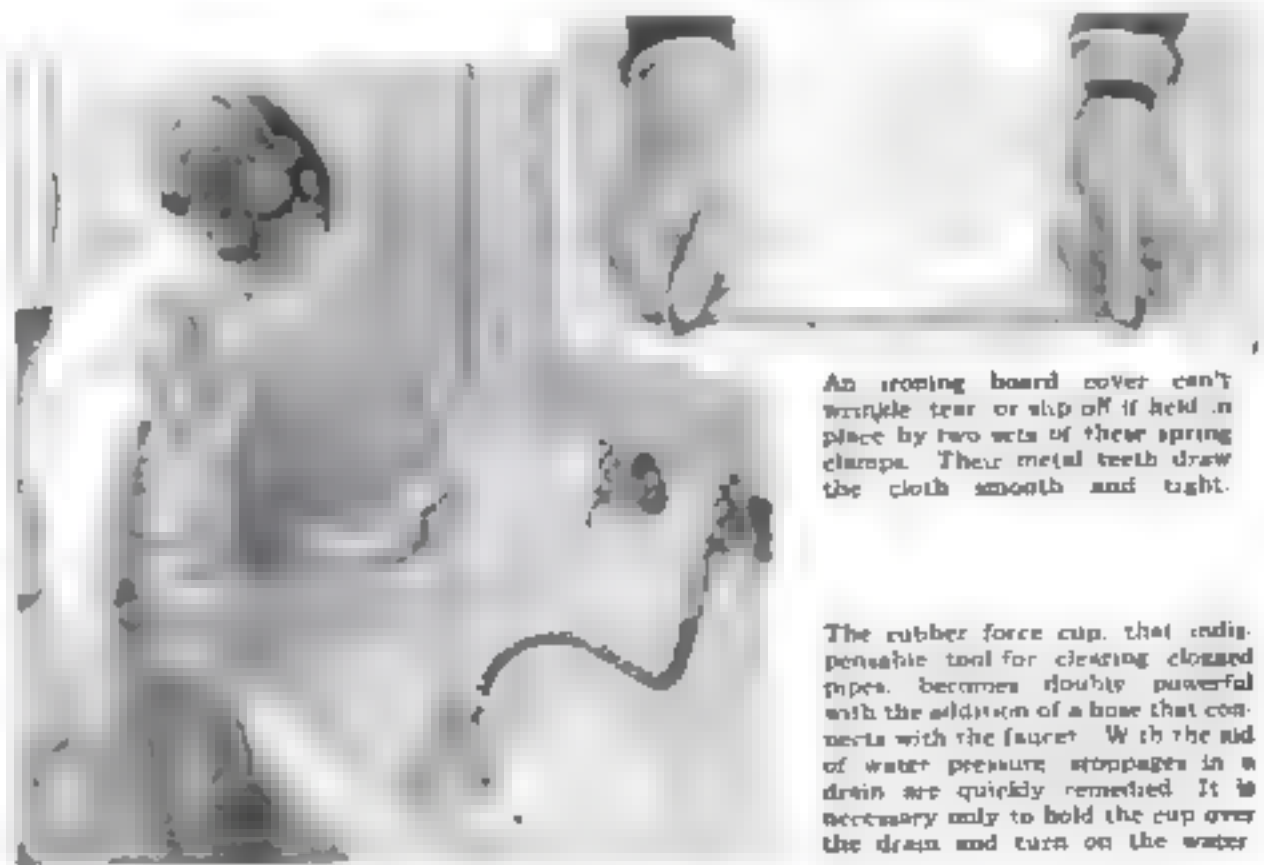
It is a simple, easy-to-use device for broiling and baking. It is made of a piece of wire, bent into a shape that fits the hand and the egg. It is used by holding the egg in one hand and the implement in the other, and peeling the egg by moving the implement back and forth over the egg.



Designed especially for oil stoves, this new broiler and baker is provided with a high, rounded top which gathers heat from the burner and directs it downward upon the meat on the grill inside. Thus, turning the meat is unnecessary. The baker fits over the burner grate.



Cooking in parchment is the latest idea for preserving the delicate natural flavors of food. Meat or vegetables to be cooked are placed in a parchment bag, which is tied at the opening and inserted in the pot or pan.



An ironing board cover can't wrinkle, tear or slip off if held in place by two sets of these spring clamps. Their metal teeth draw the cloth smooth and tight.

The rubber force cup, that indispensable tool for clearing clogged pipes, becomes doubly powerful with the addition of a hose that connects with the faucet. With the aid of water pressure stoppages in a drain are quickly remedied. It is necessary only to hold the cup over the drain and turn on the water.

Why use so many kinds of electric heating devices when one can be made to serve all purposes? That was the thought of the French inventor who devised the convertible heater shown at the right as an ironing stove and below as a combination toaster and food warmer.



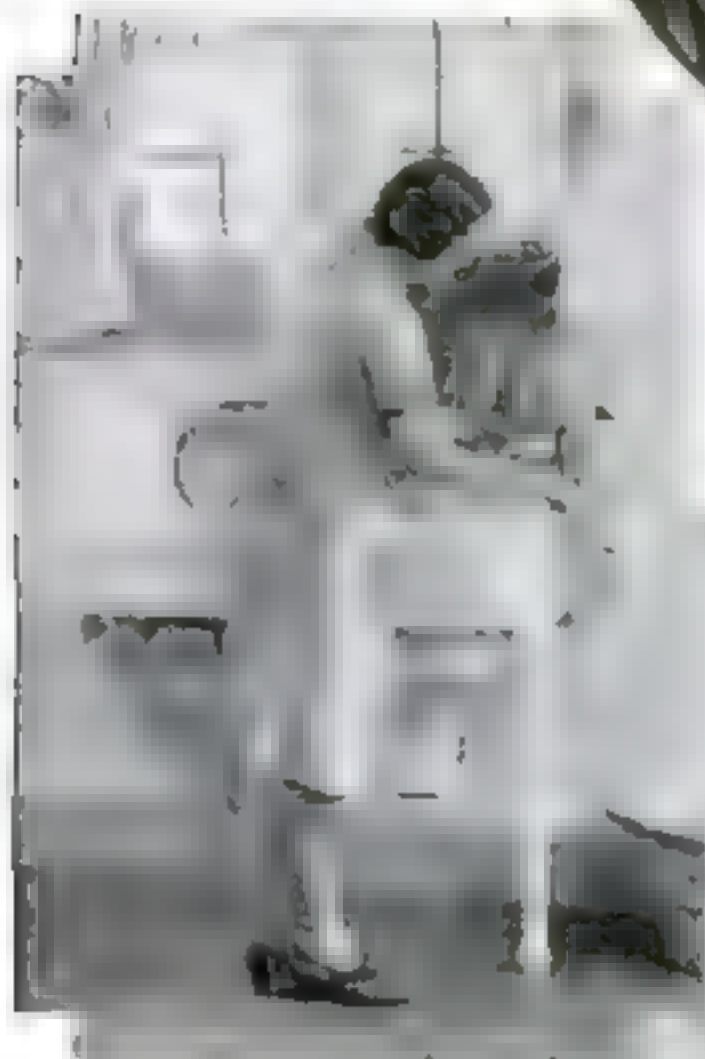
When used on the table for making toast and keeping food warm, as above, the new heater stands upon collapsible legs. For other purposes, such as ironing, the stand is folded up and the heater placed upon its side.



This novel curved brush, of "corkscrew" shape, is designed to clean usually inaccessible parts of milk bottles and fruit jars. It can even squirm into corks and beverage bottles with small necks.



Distribution of warmth by circulation instead of radiation is claimed for this unusual electric heater. Consisting of a honeycomb type radiator, three percolator units, and a standard fan, it operates to draw in cold air, warm it, and send it circulating through a room or office. It is easily portable and may be used for auxiliary heating.



There used to be no telling where a fish or pancake would land when you flipped it over. But this double turner has spring jaws which open at a touch of the thumb to grasp the fish.

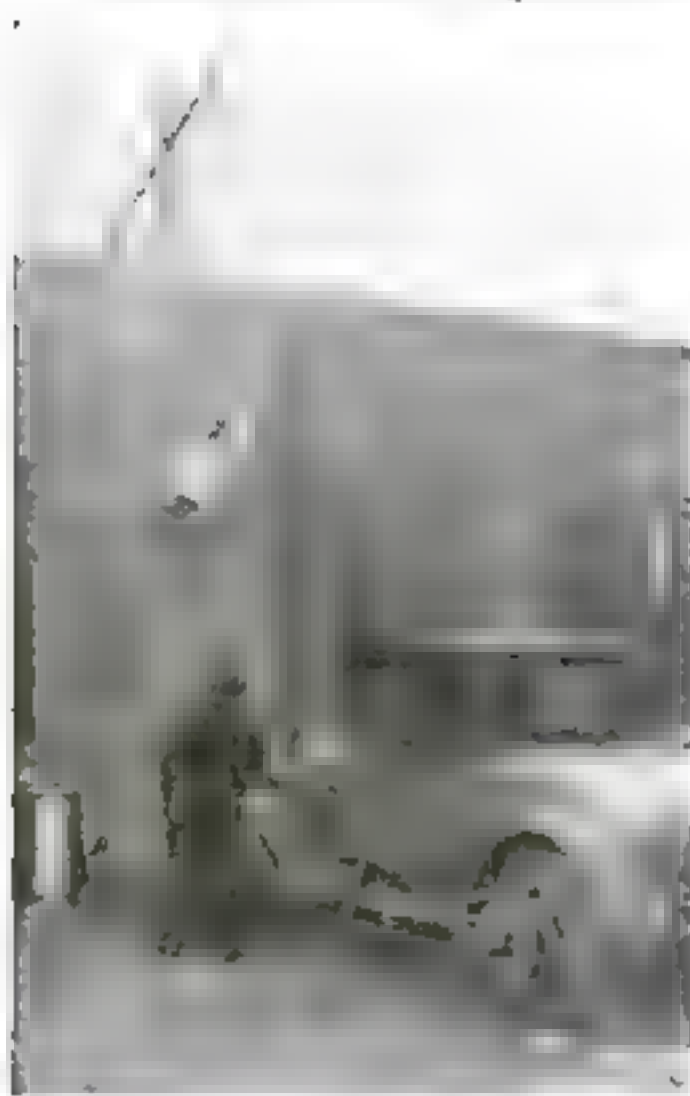


Randy new wedges, obtainable in a package of six, take the wobble out of unsteady tables or chairs. One or two blocks are used under the offending short leg. Each is bored for hanging up before use.



This combination kitchen sink and electric clothes washer for light laundering is the latest innovation for the home or apartment. It is intended especially to wash clothing which is needed immediately or which might be ruined in the regular laundry such as luncheon sets, children's garments, silk sweaters, and underthings. The equipment includes a wringer which is quickly attached to the sink, as shown above. When the washer is not in use, the wringer is removed, and the metal cover of the machine closes down to form a drainboard for the sink compartment. At right the washer in use.

Automobile Engine Drives Power Hoist



Driven from an auto rear wheel, and controlled by a single lever, this hoist can lift 800 pounds.

AN **INGENIOUS** automobile-driven hoist, designed for small fitting jobs, can be attached to the rear wheel of a motor car or truck in five minutes, according to the maker, and will lift weights of 800 pounds as high as twenty-four stories. A single lever controls it and, should the motor stop with the load in mid-air, the mechanism is designed to lower the load gradually to the ground.

The entire outfit weighs only eighty-eight pounds complete. It is intended to save the time and energy of plasterers, roofers, and contractors on construction jobs where hoisting of comparatively light materials is required.

Fawcett Slain by Indians

COL. P. H. FAWCETT, British explorer, whose disappearance in the Brazilian jungle has for three years been an unsolved mystery, probably died at the hands of hostile Indians. That is the conclusion of Commander George M. Dyott, head of a search expedition, expressed in a radio flash from out of the jungle that has just reached the world after being twice relayed.

Commander Dyott, whose expedition was described recently in *POPULAR SCIENCE MONTHLY*, reported that his men had successfully followed Fawcett's trail, and that Indian guides who knew the lost man's fate were unable to lead the search to the spot where his party's remains were buried only by reason of unfriendly tribes who blocked the way.

Thirty Billion Cups of Tea

IT **WOULD** take twenty-five average steamships, loaded to capacity, to carry all the tea used in the United States in one year. Fifty million people each year drink 80,000,000,000 cups of tea, costing seventy-five million dollars.

Know Your Car

THE most disconcerting thing that can happen on the road is for the motor suddenly to cease firing, as though the ignition switch were thrown off.

However, the manner in which the motor goes dead is a definite symptom that will help you locate the trouble. If it stops suddenly without producing any peculiar sounds, then the trouble cannot be in the carburetor; for almost any kind of carburetor trouble, including running out of gas, causes irregular running just before the motor stops. Likewise, no failure of the oiling system or the water cooling units could be to blame, and a stuck valve or mechanical trouble would be accompanied by whistling or sucking noises, or a tremendous clanking.

The ignition system is almost surely at fault and the three most likely troubles are broken wire or connection, blown condenser and short-circuited spark coil in the order named.

Discovers Alaskan Volcano

THE United States is the possessor of another volcano in Alaska just discovered by the Pavlov Volcano Expedition headed by the American expert, Dr. T. A. Jaggar. He reports that the mountain is north of Cape Bay and is 4,900 feet high. A small lake lies in its crater.

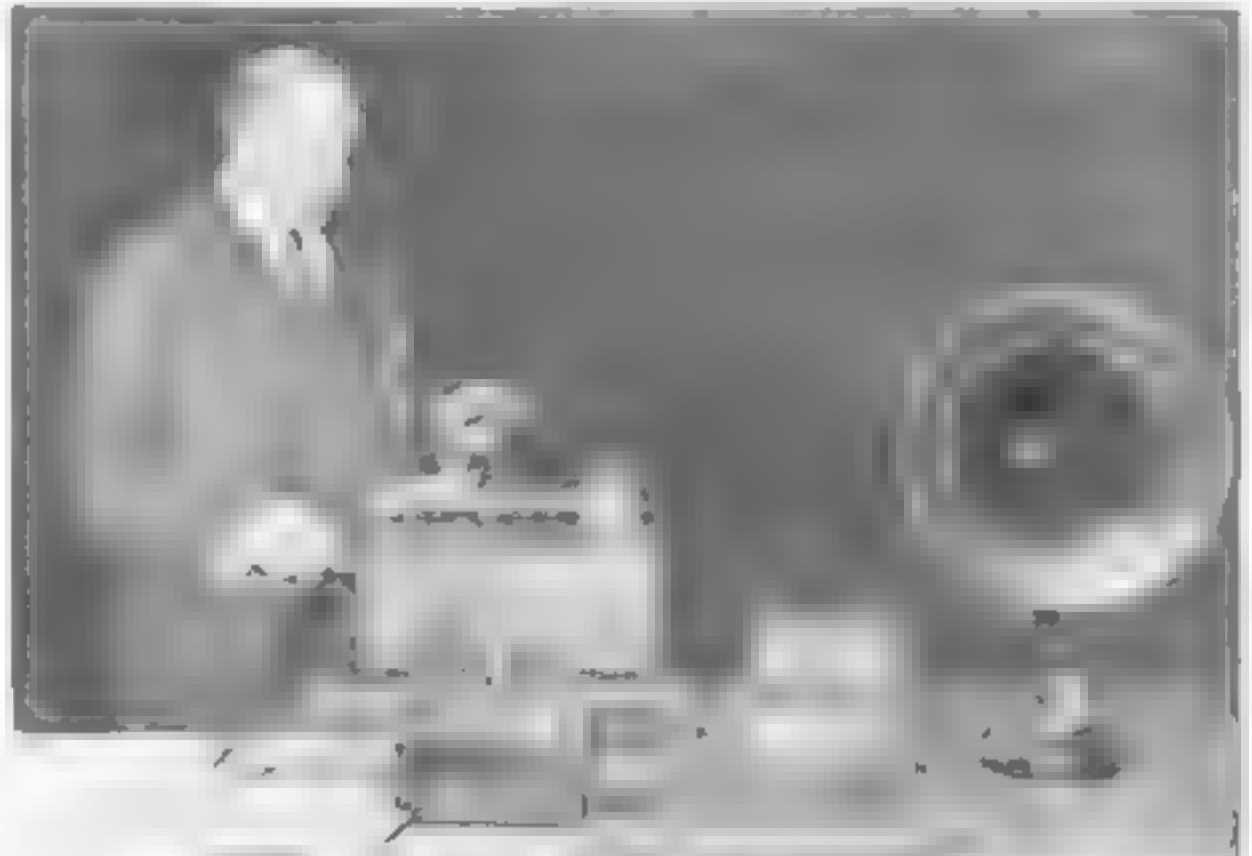
Dr. Jaggar also has reported that the ingenious amphibious auto-boat which his expedition carries has proved a decided success. Running on either land or water it has done valiant service in hauling supplies and passengers, in trolling for fish, and in transporting to camp game shot in the foothills.

Radio Pictures Received on Cylinder Records

PICTUREs sent by radio are played like phonograph records in a system of photo transmission and reception, invented by Capt. O. Fulton, and recently demonstrated in London, England. Both transmitting and receiving instruments employ revolving cylinders, not unlike the records of an old-fashioned phonograph.

The photograph to be transmitted is placed on a cylinder where, revolving, it is scanned by a beam of light. Patches of light and shadow which make up the picture are translated by a photo-electric cell into corresponding electric impulses of varying intensity. These impulses, transmitted by radio and picked up by the receiving instrument, actuate a recording device which translates them back into patches of light and shadow on a cylinder record, thus building up a half-tone reproduction of the original.

This process closely resembles the method used in sending the first radio pictures across the Atlantic.



The inventor demonstrates his system of sending pictures by radio. The receiving set, shown here, contains a cylindrical record on which radio impulses are translated into half-tone reproductions.

Value in Waste from Gas

BY-PRODUCTS of illuminating gas manufacture, which now serve only to gum up the meter in your cellar, soon may be turned to use in making plastics and perfumes worth many thousands of dollars a year. Investigating the clogging of meters, experts in the organic chemical laboratory of the U. S. Bureau of Mines have discovered that the trouble is due to gum formation from the chemical compounds, indene and styrene, always present in manufactured gas.

If completely separated from the gas, eight million pounds of styrene and twice that amount of indene would be available annually for making plastics and perfumes, and possibly in rubber making.

Know Your World

TO TEST your knowledge of the world you live in, see how many of these questions you can answer. Correct answers appear on page 150.

1. What is the world's largest island?
2. Where can natural rock salt be seen in the United States?
3. What is the driest place in the world?
4. What male bird hatches eggs?
5. What worm is called the "honorable little gentleman?"
6. Where do sheep have little carts on which to haul their tails?
7. Where did Columbus first land on the American continent?
8. What part of the world has the most sunshine?
9. To what race do the crookes belong?
10. What city loses two hours of daylight each day?
11. What is a Gila monster?
12. What produced the stone trees of the Petrified Forest?

TWO advances in the telephone service of Berlin, Germany, have resulted from the perfection of automatic instruments. For the first time, long distance calls can be made automatically from a pay station by the dial method without having to call central first. The telephone box has four slots to receive coins of as many different denominations, the amount deposited being recorded automatically in the central exchange.

Another innovation is the placing of automatic phones in booths built into the street clocks, which have been established by the Berlin Astronomical Observatory in different parts of the city.

Invents Railless Trains

A RAILLESS steam locomotive designed to haul trains over the sandstone roads of his native land has been invented by Ahmed Nassery Shalgar, a Persian studying railroading at the United States. The locomotive resembles a tractor in construction and is said to be able to pull ten passenger cars, each loaded with forty people, at a fair rate of speed.

Messages Decoded Automatically

ELECTRIC typewriting machines which automatically translate messages into secret code or decode them, as fast as a typist can write the messages, are the recent invention of Alexander von Kryha, of Berlin, Germany. The invention consists of three units—two typewriters and a central control box, all connected by a system of electric relays. As the operator taps the keys of the first typewriter, each key, in addition to printing a letter, sends an electric impulse to the control box. From there the impulses are relayed to the various keys of the second typewriter, which prints the message in code.

On the panel of the central box, a dial

which controls a series of switches has the various letters of the alphabet printed around its outer edge, and on the panel opposite the letters are the letters to be used in the code. When a certain letter of the alphabet is struck on the first typewriter, the second typewriter will receive an impulse to print whatever letter is opposite on the controlling dial. Thus, by turning the dial to vary the arrangement of opposing letters, the code used may be changed at the will of the operator.

By reversing the process, secret mes-

sages may be decoded if the setting of the control dial used by the sender is known. It is necessary only to typewrite the code message, which will be translated by the second machine.

Does Gulf Stream Reverse?

THAT the Gulf Stream—the warm current flowing eastward across the North Atlantic—turns around in the middle of the ocean and starts back toward America is the surprising phenomenon recently reported by the captains of two large trans-Atlantic ships.

This announcement led to the suggestion that the climate of England might grow colder, but scientific authorities say that the current's reversal is a local irregularity, and that there is no danger of the Ice Age returning to Britain.

A Diesel Motor for Trucks

A NEW lightweight, high-speed Diesel motor, burning a cheap grade of heavy fuel oil, is reported to have been perfected by a German manufacturer for use especially in motor trucks, buses, and railway motor cars. It may also be employed extensively as a stationary power unit—operating pumps and hoisting machinery and generating electric current.

Danger of burning out bearings, due to the high speed of rotation, is said to be eliminated by a new oiling system.



Answer: Putting in a coin at one of the automatic phone booths built into the street clocks in Berlin. Left: The new automatic long distance telephone booth made by placing coins into dialing.

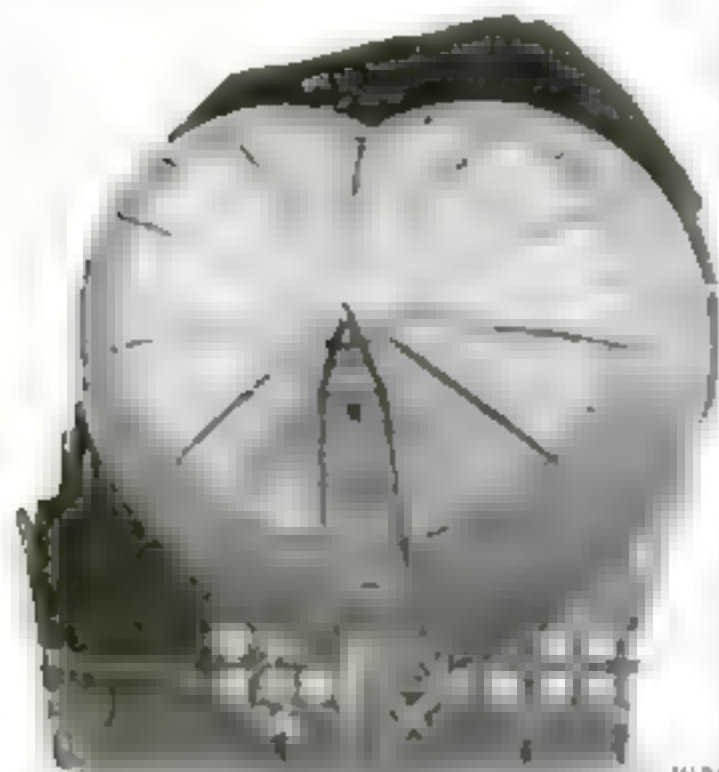


As the typist writes a message this electric apparatus automatically translates it into secret code which is typewritten by the machine at right. The latter is governed by the central instrument.

Heart Shape Keeps New U. S. Blimp on Even Keel

THE RS-1, newest lighter-than-air craft built for the U. S. Army, is designed with an unusual heart-shaped bow, the purpose of which is to increase its stability while in flight. It will be used for training and practice flights, it has been announced.

In this semirigid type of airship the keel is rigid but the gas bag is not. It keeps its shape by pressure from within.



The Army's new semirigid airship, RS-1, in its hangar at Lakehurst, N. J., ready for trial.

As gas escapes during a flight, "balloons" inside are filled with air, thus keeping the pressure constant.

The double-balloon effect at the top of the RS-1 acts somewhat as pontoons do in the water, reducing pitching of the ship in the wind.

This Mail Plane Has First Aerial Letter Box

LATE air mail can be dropped directly into a letter slot built into the fuselage of a new type mail plane recently put into service on a western air route. United States Senator William E. Borah was one of the first to post a letter in this aerial mail box recently at the air field at Boise, Idaho, just before the pilot started up his engine and took off on a flight to Salt Lake City, Utah.

Want a Name for Platinum

A DISTINGUISHING term for platinum, similar to "Sterling" for silver, is being urged by leading American jewelers to prevent unscrupulous manufacturers selling as pure platinum jewelry containing cheaper metals. The public, they say, cannot tell the difference between pure platinum jewelry and jewelry containing a mixture of platinum and palladium, which costs less. The "quality mark" would be stamped on the jewelry, together with the manufacturer's trade mark.



German Glider Thrills Americans

IN ONE of the first public demonstrations of German gliders in America, Peter Hesselbach, holder of the world's duration record of five hours for motorless flying with a passenger, recently had a thrilling escape from death at the edge of a high cliff near Highland Light, Cape Cod, Mass. By inches, his machine missed plunging over the bluff.

Hesselbach was piloting the 300-pound German glider *Darmstadt*. Pulled by an untrained ground crew, the craft failed to gain altitude. When at the last minute, Hesselbach blew the whistle that signaled them to release the rubber launching rope, the craft settled and slid along the ground until its nose overhung a 140-foot drop to the ocean's edge. In another flight Hesselbach remained aloft

for four hours and five minutes, soaring about 120 miles. The picture above shows the start of the flight.

The Cape Cod region, according to the pilot, offers better possibilities for soaring flight than many of the best spots in Germany. As was told in an article in the August *POPULAR SCIENCE MONTHLY*, Hesselbach with two companions, Capt. Paul Roehre and Dr. Paul Laubenthal, came to America under the auspices of the American Motorless Aviation Club to help popularize the sport of gliding by a series of demonstrations. Before their arrival, the American duration record for gliders of nine minutes and forty-nine seconds, established by Orville Wright in 1911, stood unchallenged, although glider flights up to fourteen hours had been made in Germany.

Saves Vast Ore Deposits

MILLIONS of tons of Wisconsin iron ore, in mines abandoned because of its high sulphur content, will be saved by a new smelting process developed by Prof. Richard S. McCaffery, University of Wisconsin metallurgist. In some mines the ore showed four times the amount of sulphur found in the output of successful mines. In the Mayville region of Dodge County a \$5,000,000 smelting plant closed down because of this inferiority.

In the new process a combination of limestone and coke is added during smelting. Limestone combining with the sand and clay in the iron ore, produces a slag of silica, alumina, lime, and magnesia, which dissolves the sulphur and removes it from the ore.

Propose Larger Golf Ball

TO MAKE the game more difficult, the British Golf Ball Committee has proposed the adoption of a new ball, slightly larger and lighter than those now used. It would cut down the length of drives. Golf authorities claim that while the proposed ball would have little effect on the game of professionals and champions, ordinary players would find their scores mounting.



United States Senator W. E. Borah posts a letter in mail plate box at Boise, Idaho.



New Sea Flea Hops 80 Miles an Hour

A WINGED motor boat, called the *Sea Flea* by its inventor, George de Lissenko, Russian engineer, made its appearance two years ago and was described in the pages of *POPULAR SCIENCE MONTHLY*. A new model of the invention has just been put through tests on Lake Teplin, near Berlin, Germany. It skims over the water in long jumps at tremendous speed. The designer expects it to lead to larger machines that will hop over the surface of the ocean like flying fish, carrying thirty passengers across the Atlantic in less than forty

hours, even through winter storms.

The first model of the invention, with tiny, nine-foot wings, began lifting the boat in sixty-five-foot hops at a speed of thirty-six miles an hour. It is reported to have traveled most of the way across the Mediterranean from Marseilles, France, at nearly a mile a minute.

Above is the latest experimental machine, equipped with larger lifting surfaces. During recent speed trials, it is said by its designer to have been clocked at eighty miles an hour.

Reliefs for the Seasick

TWO new methods of combating seasickness recently have been brought to the aid of travelers who suffer on ocean voyages. One is the invention of "antiseasickness tanks," installed on the larger steamers of the Hamburg-American line. These are in the form of great bladders along the water line of the ship. Sea water, rushing into these tanks through portholes, adjusts the ballast automatically and reduces the ship's roll.

The other is a method of treating seasickness discovered by an English physician, Dr. R. A. Bennett. It consists of a salt water bath at a temperature of about ninety degrees, to be taken when waves of sickness begin to be felt. The patient is instructed to lie in the water with his eyes blindfolded. While the bathtub moves with the ship, the water in the tub responds to the motion only slightly, so that the immersed patient remains fairly motionless. The blindfold serves to shut out sense of motion.

Six Heads on One Cabbage

THE latest wonder of agricultural experiment is a cabbage plant which produced six heads of cabbage in turn, one above the other. It was grown by Julian C. Miller, of Cornell University, who obtained the remarkable results by keeping the plant at high temperatures over a period of two years.

"Flivver" Airplane Motor Weighs Only 60 Pounds

AS STRONG as twenty horses, yet so light that a girl can lift it, a midget airplane motor just produced by an aircraft manufacturer in Sacramento, Calif., is said to be the smallest in the world. It is a four-cylinder air-cooled radial engine weighing only sixty pounds with propeller. In tests it drove a "flivver" plane ninety miles an hour.



Even a girl can lift it, yet this tiny airplane motor, air-cooled, develops twenty horsepower.

Champion Globe Circlers Set 23-Day Record

THE world shrank nearly a fifth its size, as far as time required to travel around it is concerned, the other day when John Henry Mears and Charles C. B. D. Collyer, with "Tail Wind," their white terrier mascot, landed at Miller Field, Staten Island, N. Y., in their folding-wing Fairchild monoplane, the *Coy of New York*.

They had girdled the globe by plane and steamboat in the record time of



Mears (left) and Collyer (right) welcomed by Lieut. Col. Henry W. Fleet at Miller Field.

twenty-three days, fifteen hours, twenty-one minutes and sixteen seconds. This cuts nearly five days from the previous record for the 24,000-mile trip made in 1923 by Linton Wells and E. S. Evans.

Test Striped Street Light

STREET lamps which shed striped light rather than a uniform glow are ideal for making pedestrians visible to motorists. This surprising fact was revealed in tests made by the Association of Lighting Engineers in England.

In uniform strong light, it was found, an auto driver sees a pedestrian or other object mostly by the contrast in brightness between that object and the darker background. In weak light he sees them mostly by the shadows they cast.

In one test with weak light from lamps which cast no shadows on the road, pedestrians could not be seen at all. But when this same light was altered to cast bands of light and dark, the pedestrians instantly became visible.

Experts express doubt, however, that striped light can be used effectively for road illumination, since it may hide pitfalls in the road itself.

Birds Carry Periscopes

WITHIN the eyes of ground birds are tiny periscopes, reflectors which enable them to observe the approach of enemies from behind, says Prof. Arthur Thomson, of Oxford University, England.

Keeping Up with Aviation



The City of Glendale first all-metal steam-powered airship as seen here being moved from the Glendale Calif. hangar where it was built. The strange craft designed by Capt. Thomas B. Slate is 200 ft. long and has a shell of duralumin. It has seven steam turbines, but no propellers. Instead, a blower at the rear, says Slate, will create a partial vacuum, pulling the ship at 80 miles an hour.

PRACTICAL development of the radio beacon for aircraft, achieved only this year, is to be followed by its extensive installation on commercial air routes in the United States by 1930, according to the U. S. Bureau of Standards. Through its use, pilots for the first time will be freed of fog's menace, for no longer will they be obliged to fly blind. Radio signals tell them instantly if they are off their course.

As long ago as 1920 the War Department asked the U. S. Bureau of Standards to develop a system of directing aircraft by radio. First of the methods used was the scheme of broadcasting radio beams of equal intensity pointed at different angles, from two stations. An airman could fly an approximately straight course by following a path along which the signals from the two stations sounded equally strong.

With the improved system the Bureau of Standards incorporated a visual indicator on the pilot's instrument board. In the present outfit a plane need carry only a short pole antenna and a receiver weighing but a few pounds. All of the powerful and expensive equipment is on the ground. Two white lines on a black instrument dial stretch or extend unequally before the pilot's eyes to show him whether he is flying to left or right of his course. When they are equal, he is directly on it.

Silent Planes Invisible

UNSEEN planes that make no noise may wreak havoc upon cities with their bombs in the event of future wars. This startling prophecy, made by a British aeronautical expert, is based on his declaration that already England, France, Germany, and Russia have nearly realized such a "ghost plane."

Some time ago, the French aviation

service was reported to be developing an invisible, silent airplane with muffled engine. Today, says this expert, it has been found that the propellers themselves may be quieted by the use of small air screws with six or more blades of special shape.

British experimenters have developed an airplane "dope" or paint of dull greenish tint said to make a machine flying at moderate altitude practically invisible against the sky, either by daylight or in the glare of a searchlight, at night. In Germany, tests are being conducted to devise a type of camouflage to be em-

ployed for the under surfaces of a plane's wings, intended to breakup tell-tale shadows and thus to disguise the wings' true shape and size.

Two Cross-Country Records

FLYING across the continent from Los Angeles to New York in eighteen hours and fifty-eight minutes, Col. Arthur Goebel, 1927 winner of the Dole race across the Pacific to Honolulu, recently added two more records at once to his collection of laurels. He had made the first nonstop flight from west to east across the United States and the fastest trip ever made either way.

Macready and Kelly, Army aviators who in 1923 made the only other nonstop cross-country flight on record, took twenty-seven hours to fly from New York to San Diego. Goebel not only shattered this record, but clipped three hours from the one-stop "dawn-to-dusk" flight made by Lt. R. L. Maughan, of the Army, in 1924.

Tons of Air Mail

NINE tons of air mail left Lansing, Mich., in a single shipment the other day. Eighteen Stinson-Detrolter planes carried their weighty consignment of 350,000 circulars announcing a new model automobile, to Chicago, where the leaflets were sorted and sped by air to all parts of the country.

Other firms hastening to take advantage of the new lowered air mail postage rate already have helped boost the volume of air mail nearly fifty percent,

according to post office officials; and Irving W. Glover, Second Assistant Postmaster-General, foresees another similar increase in the coming six months. Air lines carrying mail on contract have repeatedly been obliged to fly extra sections.

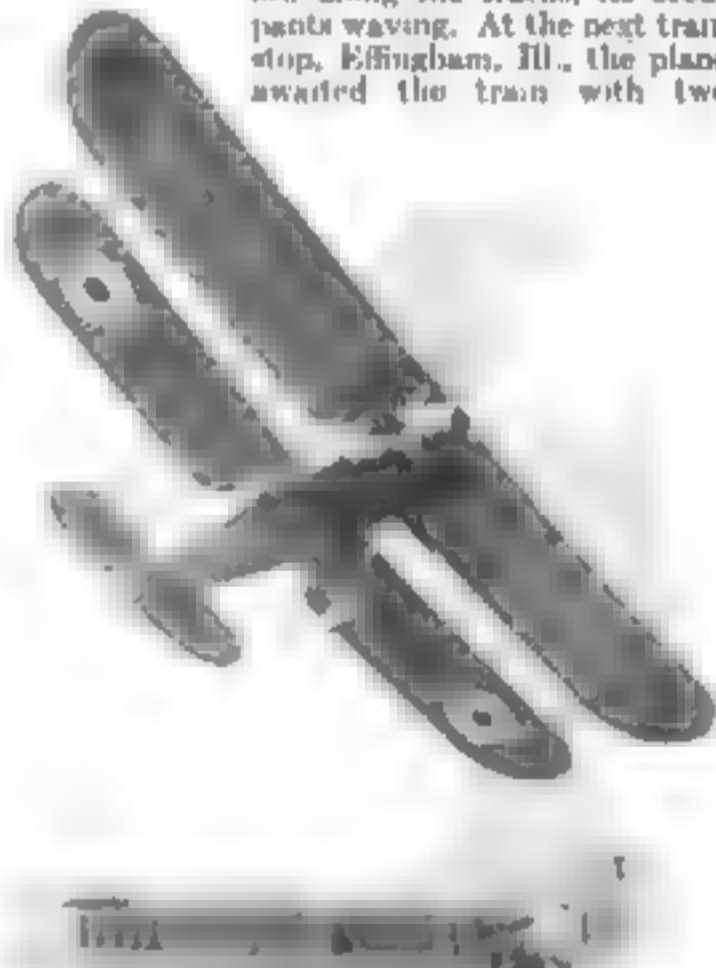
He Couldn't Come Down

FOR two minutes, it looked as if a parachute jumper at Brooks Field, Texas, was doomed to remain in the air indefinitely. He had the recent novel experience, according to the War Department, of jumping from a plane into a powerful rising wind current that suspended him practically motionless at an altitude of 2,000 feet above the earth.

It was his first parachute jump and he was wondering what he should do next in order to come down, when the updraft slackened and he gradually descended to earth at the record speed of three feet a second.

Link Air, Earth, and Sea

EVEN before the first air-rail line in this country went into operation in September, extending rail service by air between Chicago and the twin cities of Minneapolis and St. Paul, another part of the country saw an actual air-rail passenger transfer. Passing Smithboro, Ill., Guy Hickman, engineer of the Pennsylvania Railroad's Gotham Limited, observed a large passenger plane flying low along the tracks, its occupants waving. At the next train stop, Effingham, Ill., the plane awaited the train with two



This is the newest of British fast fighting planes, the Hawker Newfinch biplane, winner in recent trials to select machines for the Home Defense Squadron of the Royal Air Force, to be centered near London. In speed tests, pilots of this squadron got into their tops and rose 10,000 feet in the air in fighting formation—all in seven minutes.

New Radio Beacons to Safeguard U. S. Airways; Unusual Planes and Remarkable Flying Records

women passengers for New York. They had come by air from Tulsa, Okla., to catch it and had flown low to identify the train as the one they wished to board.

Elsewhere air facilities have been linked to advantage with other modes of travel. Germany has just effected an elaborate hook-up between its entire air and railway systems for the speedy transportation of freight. Five-hundred-mile ship-to-shore flights inaugurated by the French Line steamer *Ile de France* are saving twenty hours in delivery of mail at New York and at Cherbourg, France. Additional planes are to be provided for longer, 800 mile flights and will carry passengers. Other steamship lines are contemplating similar service. During the last five months, Canadian planes have transferred mail by air from incoming steamers at Rimouski, Quebec, at the mouth of the St. Lawrence River, to Toronto, arriving there hours before the boat.

Highest Beacon on Stamp

STAMP collectors who have just placed the new five-cent air mail stamp in their albums, and others who use it will be interested to know that the design is not an imaginary but an actual scene. Ten thousand feet above sea level, the world's highest air beacon near Cheyenne, Wyo., guides planes of the Boeing line between Chicago and San Francisco and the picture on the stamp represents this light.

Now Canada, too, announces an air mail stamp. Such air mail postage issues, of countries in all parts of the world, offer a new specialty to those who collect stamps as a hobby. Its enthusiasts have recently formed for their mutual benefit the National Air Mail Society, at Chicago, Ill.

How to Use the Air Mail

FOR those who are still uncertain just how to use the air mail and what advantages it offers, the U. S. Post Office

issues the following information:

Letters marked "AIR MAIL" or stamped with a red stamp will be carried to any part of the United States at a special saving of time from four days to two and a half days.

The new air mail rate is five cents for the first ounce and ten cents for every ounce thereafter. No additional postage is required.

Either ordinary stamps or special air mail stamps may be used. If ordinary stamps are



United States replace stamps that have been used on letters marked "AIR MAIL" with a red stamp. The new air mail rate is five cents for the first ounce and ten cents for every ounce thereafter. No additional postage is required.

letter should be plainly marked "AIR MAIL." Air mail stamps of various denominations may be obtained at all post offices.

Letters sent via air mail may be posted at any post office, in any regular mail collection box, or in special collection boxes for air mail only. If placed in ordinary mail boxes, the collection time shown on the box should be noted for guidance.

Letters for air mail dispatch should be posted sufficiently early to connect with departing planes. Practically all collection boxes show the latest time in which air mail may be deposited therein. Air mail schedules may be obtained from your local postmaster.

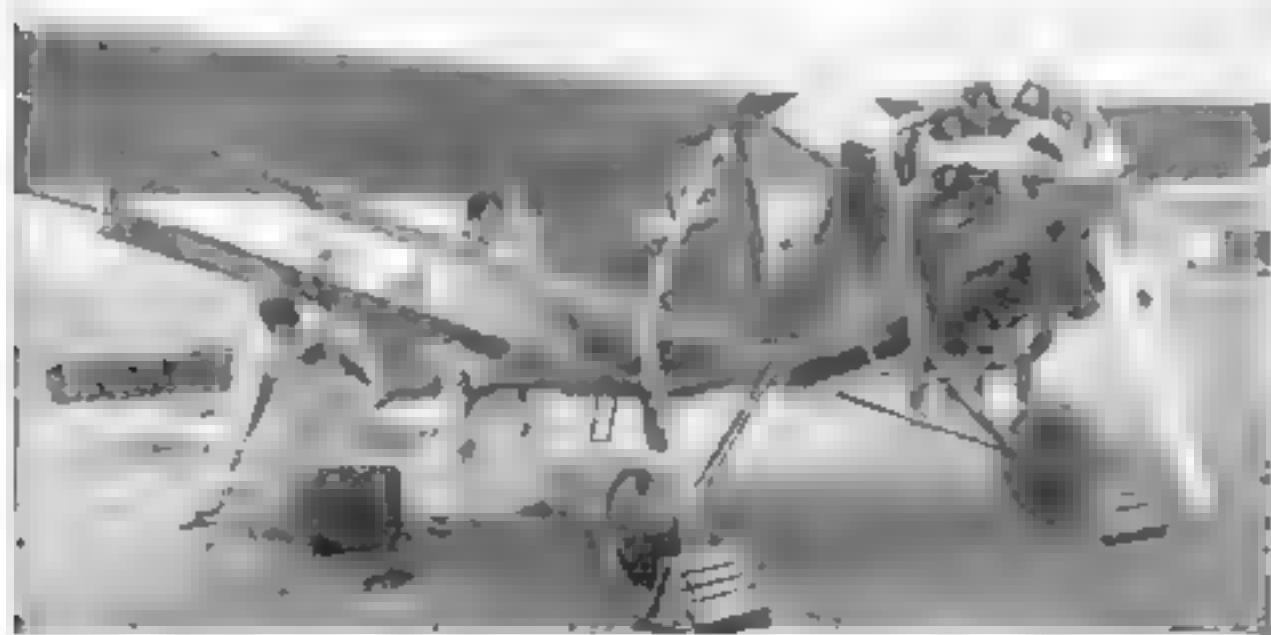
Air Line Network Grows

OVERNIGHT the mail and passenger network that spans the United States is undergoing mushroom development. This month should see the new air line of the Canadian Colonial Airways, between New York and Montreal, in operation despite delays in securing airports and arrangements for night lighting. Actual survey has begun on the Miami-to-Panama route scheduled to be operated by the Pan-American Airways in January. The long-awaited U. S.-Mexico air mail may be realized any day.

Within the United States, planes of the United States Air Transport already are carrying passengers between New York and Washington in two and a quarter hours, at a fare of \$30. Texas is blanketed by the new air lines of the Texas Air Transport, and the state of Michigan by those of the Thompson Aeronautical Corporation. Chicago has new routes to Louisville, Ky., and to Madison, Wis. Before many months, a proposed air line may slice the country from Chicago to Miami, Fla. The eastward section of this line from Atlanta, Georgia, to Miami is already under mail contract, though not yet operating.

Airport Traffic Signals

TRAFFIC signals direct planes landing and taking off at the Oakland, Calif., municipal airport. An airplane control station with a system of signals resembling those of a railroad has been erected on top of the administration building at the airport.



One of the latest developments in commercial planes is the new Curtiss Robin, a cabin monoplane. It is capable of carrying 700 pounds of freight or passengers, or a mixed load of both.

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A Problem in Addition

MOST great inventions and scientific achievements are, after all, merely object lessons in adding two and two to make four.

The elementary principles of electromagnetism, for example, were well known to scientists for years. Then along came an artist named Morse who added them all together and got a result in the telegraph that revolutionized human communication.

Years went by. Alexander Graham Bell took Morse's telegraph, latched on more known ideas, and the world gasped in amazement at the telephone.

Now who will solve another similar problem in scientific addition? Who will produce the really perfect motion picture? Such a picture must be one which makes the observer believe he is seeing the real thing and not a reproduction. It must at once show form, color, sound, and perspective.

Our present motion pictures have form. Expert photography has seen to that. Sound we have, too. Eastman recently has produced motion pictures in color for amateur photographers. Photography in full perspective has been a fact for years. The stereoscope and a packet of views were common objects on the parlor table thirty years ago.

A pretty problem in addition, to sum these known scientific achievements into a homogeneous total—the perfect motion picture. And if you wish to tackle a still harder problem, try to add the theoretical possibilities of television to the sum and produce the perfect motion picture by radio!

When Trifles Count Large

IN AN eighteenth century laboratory two pieces of metal attached to a galvanometer, were thrust into a salt solution until they touched the leg of a dead frog. At that moment, the experimenter noticed the galvanometer move. He announced that the source of electrical current was frog's legs. Volta, maker of the first battery, disagreed. He said the action of the solution on the metals produced the electricity.

So, an argument over frog's legs gave us the electrical battery. The accidental splitting of a piece of steel brought the steel pen. A twisted pasteboard box suggested wing-warping and made the airplane possible. A chance meeting in an auto bus gave us new knowledge about twins, as is told in this issue.

"Almost everything comes from almost nothing."

Aviation's Deep Riddle

ATTEMPTING a solo flight in his new airplane, Fred Stone, famous comedian, recently crashed and suffered severe injuries. If Stone were an ordinary actor, the incident might be dismissed as one of those unavoidable mishaps of flying training.

Stone, though, in his own particular way, probably was the most versatile genius that ever lived. He was a dancer, an acrobat, a trained athlete. He could walk a tightrope, ride a bucking broncho, twirl a lariat with the skill of a Will Rogers, he had boxed with champions, played polo with international stars. He was driving an automobile when one garage could have housed all the cars in the United States. He played baseball well enough to have been a big leaguer. He has lassoed Polar bears on the Arctic ice. He was an expert at fancy ice skating, juggling, rifle shooting, and welding the bull whip.

He was, in short, a marvelous physical specimen—just the sort of man, you would say, who would make an excellent aviator. Yet, after an adequate period of training, he came to grief almost the first time he essayed to fly alone.

Such a happening must cause us to wonder whether aviation enthusiasts are not unduly optimistic in predicting that some day every man will pilot his own airplane. It gives peculiar significance to the article in this issue by Dr. L. H. Bauer, Medical Director of Aeronautics, Department of Commerce, on the physical requirements of pilots.

Are good aviators, after all, a breed apart?

Steam Heat for Nothing

WITHOUT warning, a great new geyser recently roared from the ground in Yellowstone National Park, Wyoming. Today it is spouting steaming water, at fifteen-second intervals, sometimes to a height of 100 feet. Its present output of hot water would form a stream four feet wide and eight inches deep, flowing 120 feet a minute.

In California and in Italy, volcanic steam has been harnessed for industry. Iceland is preparing to pipe boiling water from its famous geysers and hot springs to heat homes in a region where coal and wood are scarce, just as steam is distributed from central heating plants in large American cities.

In Yellowstone Park there are about 100 eruptive geysers and some 3,000 hot springs, all unused. Every so often Nature reminds us, with some magnificent new display, of the wealth stored in the earth. This time, the leaping steam of a second "Hell a Half Acre" advertises enormous underground boilers, worth millions of dollars to men who can put them to work.

They Are Saying—

"THE earth was split off from the sun as a ball of fire of high temperature about 1,600,000,000 years ago."—Dr. A. J. Nernst, University of Berlin.

"Germany needs aerial patrolmen right now and in a few years all Europe and America will have flying policemen."—Prof. Otto L. Shreber, Königsberg University.

"Neither the new British nor the new German dirigible can be successful commercially."—Capt. Anton Heinen, builder of the *Los Angeles*.

"When we look at a photograph or at a movie film, we are really crystal gazing, seeing on a square inch of film more crystals of silver bromide than there are human beings on the earth."—Dr. C. E. Kenneth Mees, Eastman Kodak Co.

"Of the 1,177 different kinds of trees found in the United States, 137 have special medicinal virtues."—Prof. Ernest F. Stehr, Oregon State Agricultural College.

"Employment of scientific knowledge in government ought to come as naturally as the employment of a doctor or a plumber."—Dr. Graham Wallas, British political scientist.

"Five percent of chewing gum is rubber."—Dr. W. L. Semon, noted rubber authority.

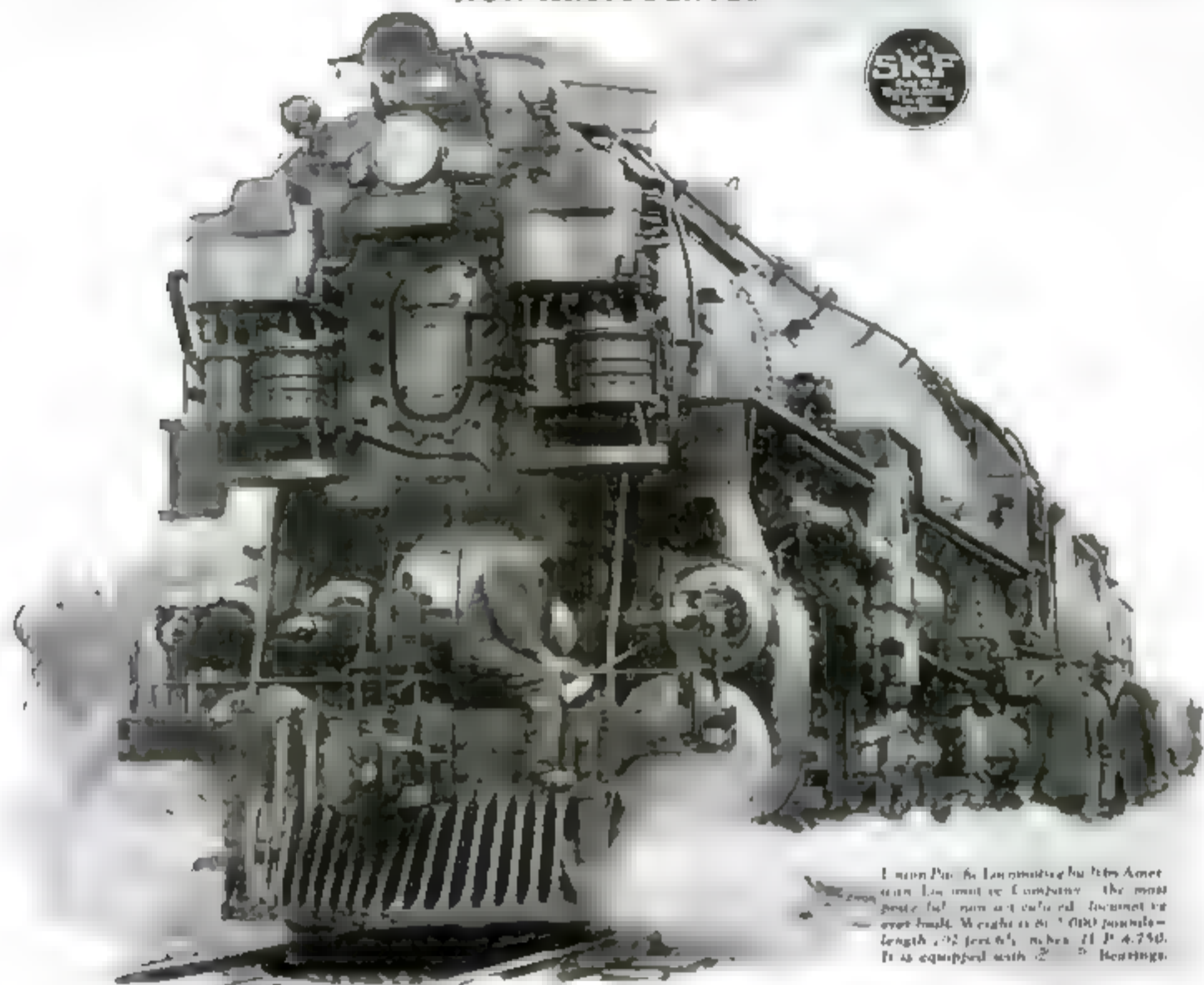
"The average unskilled laborer now works four hours a day to pay for food for his family and less than ten minutes for lighting his home."—Dr. M. Lukesh, National Lamp Works.

"When the need comes, the chemist will convert the light of the sun and the nitrogen of the air into food for the human family."—Dr. H. E. Barnard, Indianapolis.

"With calcium sulphate, science hopes to get to so-called absolute zero, a fridity of 459 degrees below zero."—Prof. B. S. Hopkins, University of Illinois.

THE MOST *POWERFUL LOCOMOTIVE IN THE WORLD

*NON-ARTICULATED



Union Pacific Locomotive built by American Locomotive Company—the most powerful non-articulated locomotive ever built. Weight is 807,000 pounds—length 102 feet 6 inches. It is equipped with SKF Bearings.

EQUIPPED WITH THE HIGHEST PRICED BEARINGS IN THE WORLD

A BIG, hulking monster of the rails—807,000 pounds in weight—102 feet in length—the most powerful non-articulated locomotive ever built.

And, at the other extreme, a veritable pigmy among locomotives that hauls and thrills kiddies at an amusement park.

Both are equipped with **SKF** Anti-Friction Bearings!

SKF is the railway bearing of the world. It is used on more railway passenger cars, more locomotives, more auxiliary locomotives than all other



One of the smallest locomotives ever built, operating at Euclid Beach, Cleveland, also equipped with **SKF** Bearings.

makes of bearings combined. It has been in use, not for a few short months, not on a single railroad, not on a few cars, but on 25,000 cars, on the railroads of twenty-two countries throughout the world and for a period of twelve years!

For the railroad man, with his keen insight into values and his cold calculating consideration of PERFORMANCE, appreciates, perhaps as no other can, that "Nothing Is Apt To Cost So Much As A Bearing That Cost So Little".

SKF INDUSTRIES, Inc., 40 East 34th Street, New York City

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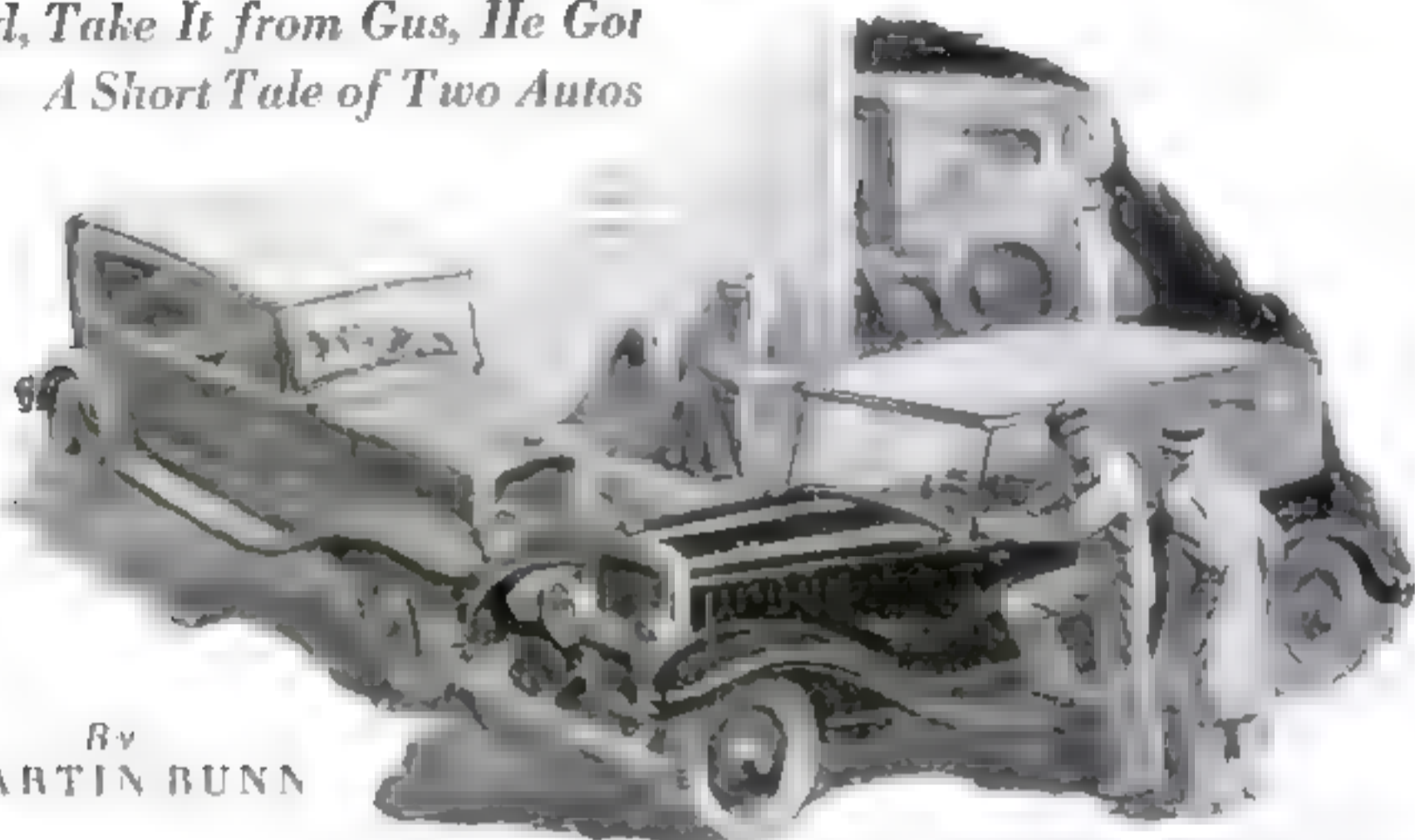
BALL AND ROLLER BEARINGS

Nothing Is Apt To Cost So Much As A Bearing That Cost So Little

He Wanted a Used Car Bargain

And, Take It from Gus, He Got It! A Short Tale of Two Autos

By
MARTIN BUNN



From the feel of it—said Gus, this creak's been driven forty thousand miles if it's gone an inch.

"I'M a mechanic, not a blooming auto salesman," Gus Wilson grumbled as Joe Clark, his partner in the Model Garage, finished reading the letter he held in his hand.

"Why be so grouchy?" grinned Joe. "Hamilton was a good customer and we ought to be willing to do something for him. It wasn't his fault he got transferred to San Francisco so suddenly. All he asks us to do is sell his car for the best price we can get and send him what's left over after taking out what he owes us."

"All right," Gus agreed. "Put an advertisement in the paper. We ought to get a couple of hundred more than the current price for a car of that make and year. Mechanically it's practically as good as new. Hamilton always handled it as carefully as a crate of eggs."

Several prospective buyers answered the advertisement, but only one showed real interest. It appeared that he had been looking for a secondhand car of that particular model for some time.

"What gets me," growled the prospect, "is how you have the nerve to ask so much. I've seen other cars that looked just as good that I could have bought for a lot less."

"THIS car's worth more, Mr. Estey, because it's in exceptionally good condition," Gus insisted.

"Aw, rats! That's what they all say," Estey sneered. "I guess I'll keep on looking." And he walked out.

"Humph!" Gus grunted to Joe. "There's another bargain hunter who's going to get stung before he's through."

Several days later Estey drove up to the Model Garage in a car like the one the two garagemen were trying to sell for Hamilton.

"What do you think of this boat?" he called, as he stepped from his car. "Just stopped around to show you high-binders I know a bargain when I see one. I bought it from a dealer over in Flintville for two hundred less than you wanted for yours. You ought to drop your price at least three hundred after seeing this."

And, at first glance, Estey's purchase appeared worth at least that much more than the other. Gus walked around it several times, eyeing it keenly.

"Thanks for showing it to us, Estey," he said pleasantly. "Now that I see what you can get for the price you paid, I'm going to raise mine another hundred."

"What are you trying to do, kid me?" snapped Estey.

"NOT at all," Gus replied. "You asked me what I thought of your purchase and I'm telling you my first impression. Let's trundle it around a bit and see whether I ought to apologise."

Gus climbed behind the wheel and Estey got in beside him. The gray-haired mechanic eased the lever into first and let in the clutch very gently, but the car started with a jerky motion. Then he threw it into second and stepped on the throttle. There was a grinding roar from the gears as the car picked up speed. He dropped into high and again gave it the throttle. A whining hum became quite audible.

"Sorry, Mr. Estey," said Gus, "but I'm afraid I can't take back what I said. From the feel of it, this creak's been driven forty thousand miles if it's been driven an inch."

"Look at the speedometer," snapped Estey. "It shows the car's been driven

only a little over eight thousand miles."

"Turning the speedometer back is what they call 'reconditioning' in the 'gyp' secondhand auto business," Gus explained. "That, and slapping on the cheapest coat of paint they can get."

"YOU'RE sore because I didn't buy from you," grinned Estey.

"Humph!" Gus growled. "Why should I be sore? I'll find a customer for that car all right. I haven't been in the auto business since the days of the one-lung chugger without learning something about the critters. And if you want to know how I know this car's a worn-out old wreck, I don't mind telling you. Notice how that clutch works? Kinda rough, isn't it? That's because the clutch lining is almost worn out. Did you hear those gears growl in second with a sort of a cackling noise? That's worn gears with a few chips knocked out of them, and probably loose transmission bearings in the bargain. And you'll notice there's a pretty stiff whine whenever I give it the throttle. A rear end has to be in pretty rotten shape to make so much noise. And from the muffled effect, I'm almost sure both the transmission and the rear end are full of fine sawdust. That's a regular trick to quiet gears. We'll find out about that when we get back to the garage."

"I'll believe that when I see it," Estey growled.

"There's a plenty you could have seen if you'd only looked for it," said Gus. "Look at that clutch pedal. It's a dead give-away. No clutch pedal could be so worn in any eight thousand miles. And the brake and

(Continued on page 154)



**A Radiotron
for every purpose**

RADIOTRON UX-221-A
Detector Amplifier

RADIOTRON UV-199
Detector Amplifier

RADIOTRON UX-199
Detector Amplifier

RADIOTRON WD-11
Detector Amplifier

RADIOTRON WX-12
Detector Amplifier

RADIOTRON UX-204-A
Detector Amplifier

RADIOTRON UX-130
Power Amplifier and
Audio Stage Unit

RADIOTRON UX-222
Screen Grid Radio
Frequency Amplifier

RADIOTRON UX-112-A
Power Amplifier

RADIOTRON UX-171-A
Power Amplifier and
Audio Stage Unit

RADIOTRON UX-210
Power Amplifier Oscillator

RADIOTRON UX-346
Detector Amplifier for
Broadcasting and
Amplification

RADIOTRON UX-254
Power Amplifier

RADIOTRON UX-226
A.C. Filter

RADIOTRON UV-227
A.C. Heater

RADIOTRON UX-200
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RADIOTRON UX-874
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RADIOTRON UV-886
Ballast Tube

The standard by
which other vacuum
tubes are rated

RCA Radiotrons are standard equipment in fine radio sets of all leading manufacturers. The RCA mark on the vacuum tubes of any radio instrument is one of the first tests of its excellence.

To maintain high quality performance in your radio set, replace all the vacuum tubes with a new set of RCA Radiotrons at least once a year. Do not put new tubes with old ones that have been *long* in use.



Look for the mark
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RCA Radiotron

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RADIO CORPORATION OF AMERICA • NEW YORK • CHICAGO • SAN FRANCISCO

These Kinks for Your Car May Come in Handy

If You're Stuck in the Mud

Or if You Break an Axle, There's a Simple Way Out of the Emergency Ideas Which, if Heeded, Make Hard Jobs Easy

ONE man can pull a car out of a bad mud hole with a rope, a stake driven into the ground and a wooden pole such as a fence post or a limb of a tree. Fig. 1 shows how it is done. The forked stick which translates the pull into upward motion is not absolutely necessary, but will help a good deal.

Tie one end of the rope to the car axle and tie the other end to the stake, leaving plenty of slack. Now pass the rope loosely around the pole a couple of turns, insert a stout stick under the part of the rope leading to the car, and pass one end of the stick back of the pole. The stick forms a lever that will multiply your pulling force many times. The stouter the pole the greater the leverage.



Fig. 1. How an emergency lever can be improvised to enable one man to pull a car out of the mud.

runs the oil pressure up to the regular running point. If anything goes wrong with the oiling system, the gage pointer will touch one of the fingers and the light will flash a warning.

A Handy Jack Base

YOU can simplify the problem of slipping the jack under the rear axle by making the folding base for the jack, shown in Fig. 3. Cleats hold the jack in place.

The length of the base can be made to suit the car and the hinges can be located to make the base fold it to the tool box.

Cotter Pin Extractor

THE design for a simple, homemade cotter pin extractor that will pull the tightest pin with ease is shown in Fig. 4. A metal collar is welded near one end of a piece of drill rod. Then a sliding iron weight is fitted to the rod and the other

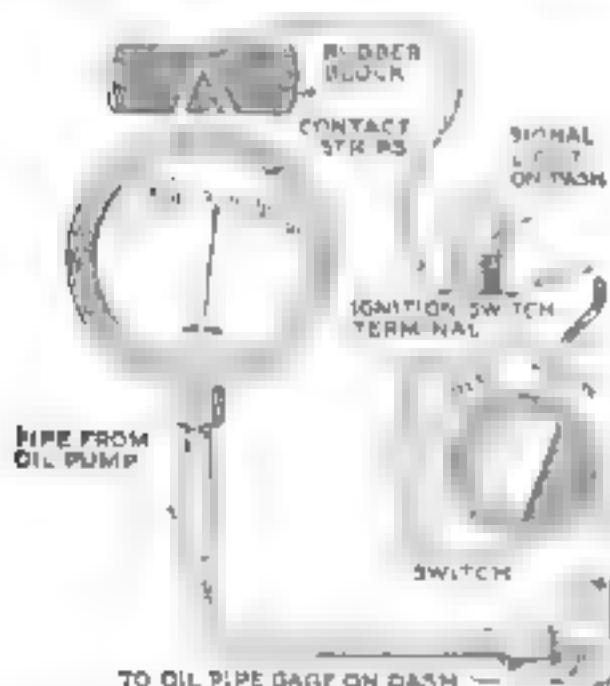


Fig. 2. A warning signal light wired as shown in this diagram, may save damage to your motor.

Oil Failure Warning Light

WHILE the oil gage on the dash indicates plugged oil pipes by registering excessive pressure, or oil-pump failure by a low pressure reading, you may not happen to look at the gage. Figure 2 shows how to install an electric indicator lamp that will immediately call your attention to any oil failure in case you do not notice the warning of the oil gage.

Procure an extra oil gage and mount it on the back of the dash. Remove the glass. Mount a fiber or rubber block just above the gage and on it fit a couple of light brass fingers arranged to make contact with the gage pointer. The proper settings will, of course, depend on the characteristics of your particular car.

Wire a dash indicator lamp as shown. When the ignition is turned on the bulb will light until the starting of the motor

Ten Dollars for an Idea!

THIS month's \$10 prize goes to J. L. Longino, of Pine Bluff, Ark., for his suggestion of the handy jack base shown in Fig. 3. Each month POPULAR SCIENCE MONTHLY awards a prize of \$10, in addition to regular space rates, for the most useful ideas for motorists. Other contributions are paid for at usual rates. Address the Technical Editor, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York.

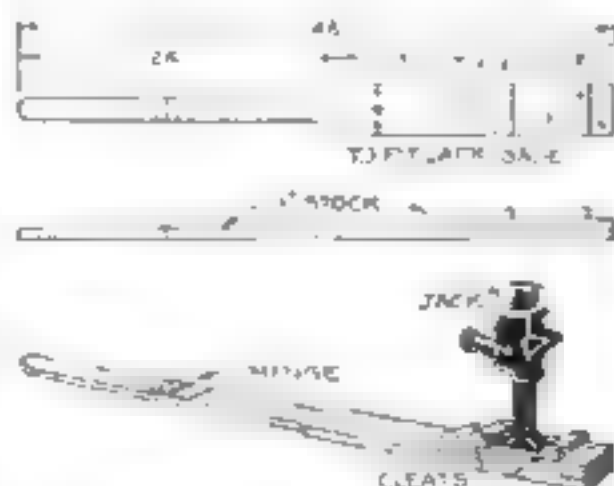


Fig. 3. It's simple to build this folding jack base which simplifies the otherwise awkward job of slipping the jack under the car's rear axle.

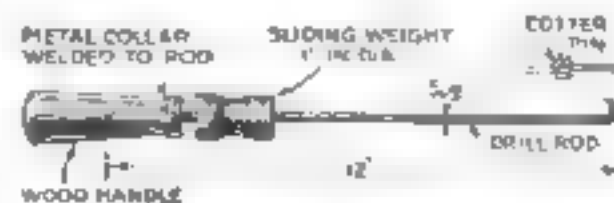


Fig. 4. With the hook inserted in the cotter pin eye, forcing the weight back pulls out the pin.

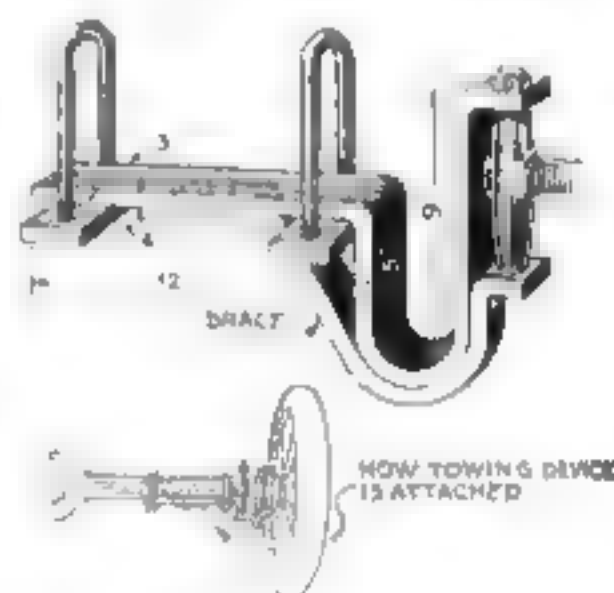


Fig. 5. An emergency towing axle made from two U-bolts, some strap iron, and a front axle.

end of the rod is pointed and bent into a hook. To use, hook into the eye of the cotter pin and move the sliding weight forcibly against the handle. A few hard blows are generally sufficient to remove the most stubborn cotter pin.

A Towing Axle from Scrap

TWO U-bolts, some pieces of strap iron, and a front axle can be fitted together to form the emergency towing axle shown in Fig. 5. If the car axle has broken off at the wheel, this auxiliary axle can be bolted to the axle housing, making it possible to tow the car to a service station where the broken axle can be replaced.

The making of a **CeCo** TUBE

PROBABLY no manufacturing process is more exacting or requires greater skill and precision than the making of radio tubes.

First among the exacting steps is the assembling of the grid. Then comes the mounting of the elements on the glass stem, and in setting into the open end glass bulb and sealing the stem to the bulb.

Evacuation of the air and gases within the bulb by a special exclusive CeCo process then follows, and after "flashing" to remove all gases clinging to the sides of the bulb, the tube is "aged" by burning the filament at an abnormal filament voltage, thus "priming" it ready for use.

Finally tubes are tested for all characteristics and the close test limits assure every CeCo Tube being uniform and worthy of bearing the CeCo label.

Description of CeCo tubes here illustrated

Type M-26 (126) Amplifier: A $2\frac{1}{2}$ volt 4 prong. LX base 1.05 amp A. C. tube for operation on alternating current through a step down transformer.

Price \$2.50

Type N-27 (127) Detector and Amplifier: A $2\frac{1}{2}$ volt separate heater type A. C. tube. While generally a detector tube, it may be used as an amplifier as well. Having 5 prongs its use requires a 5 prong socket and operates from A. C. current through a special down transformer.

Price \$5.00

for A-C Sets



UNTIL you actually hear these remarkable CeCo Tubes perform in your own set, you have no idea of the clear bell-like tone and beauty of reproduction they make possible. Long wearing, too—these CeCo's (and, incidentally, there is one for every radio need). A new and exclusive process of evacuation not only gives them greater clarity and sensitivity, but makes them last longer as well. Try them.

Write for a copy of our booklet, "Getting the Most Out of Your Radio." CeCo Tubes are for sale by the best dealers everywhere.

CeCo Manufacturing Co., Inc., Providence, R. I.

Trick-Performing Puppy



*Made of Wood and Worked by Strings
—Four Other New, Inexpensive Toys*

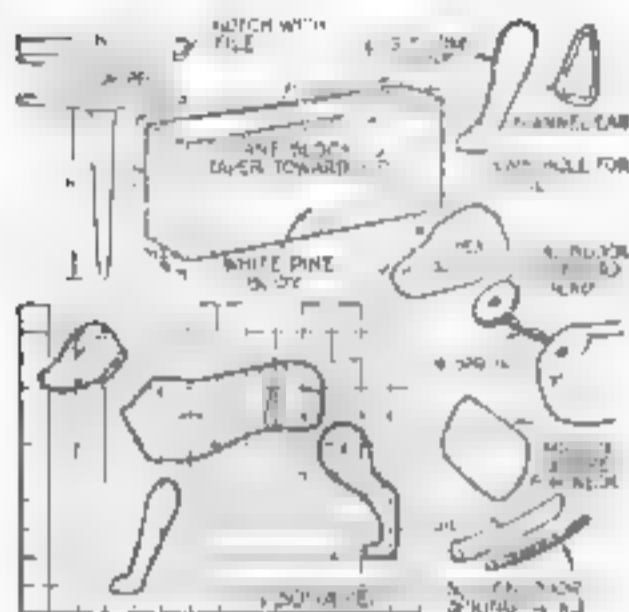


Fig. 2. How the parts of the toy dog are prepared: neck joint and tail and top view of the controller for pulling the strings.

to be nailed to the base of the head. This is so that the white muslin neck "sleeve" can be tacked on neatly. A hole should be bored in this oval piece and in the body block to receive a section of coil spring, which should fit tightly. The legs are shaped with coping saw or jackknife from the thin white pine. They should move freely when nailed in place.

Note that the black spots on the dog are so arranged that they cover the leg joints. For the pupils of the eyes use black head-head pins cut off to about $\frac{1}{2}$

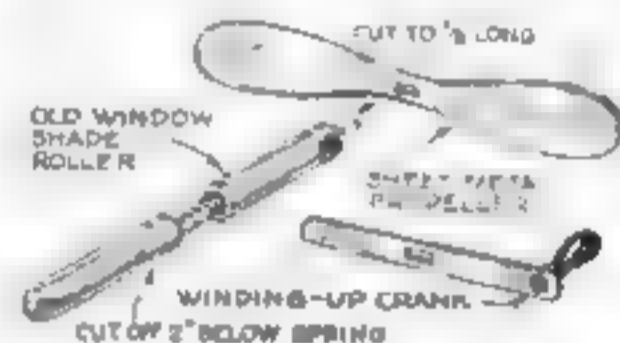


Fig. 3. Old shade roller adapted for spinning a flying propeller at great velocity.

in. Make the ears of heavy Banol hemmed as shown. Over the coil spring tail, slip a cover made from a silk stocking, with the hem turned inside.

The control bar is of the type originated, I believe, by Tony Sarg; at least, it is recommended by him for amateur work with marionettes. It consists of a cross made of two strips of $\frac{1}{4}$ -in. pine, 7 by 6 in. long respectively. Another 6-in. strip is used for the head control, this is separate from the cross, but when not in use is supported by a peg on the end of the cross.

The head is supported by stout black threads attached to each side forward of the ears, or in whatever

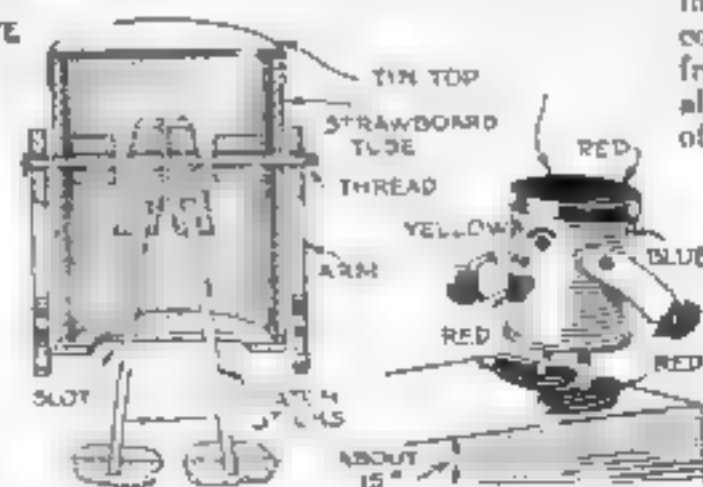


Fig. 4. Toy automaton which toddles down an incline on its legs when it is properly balanced.

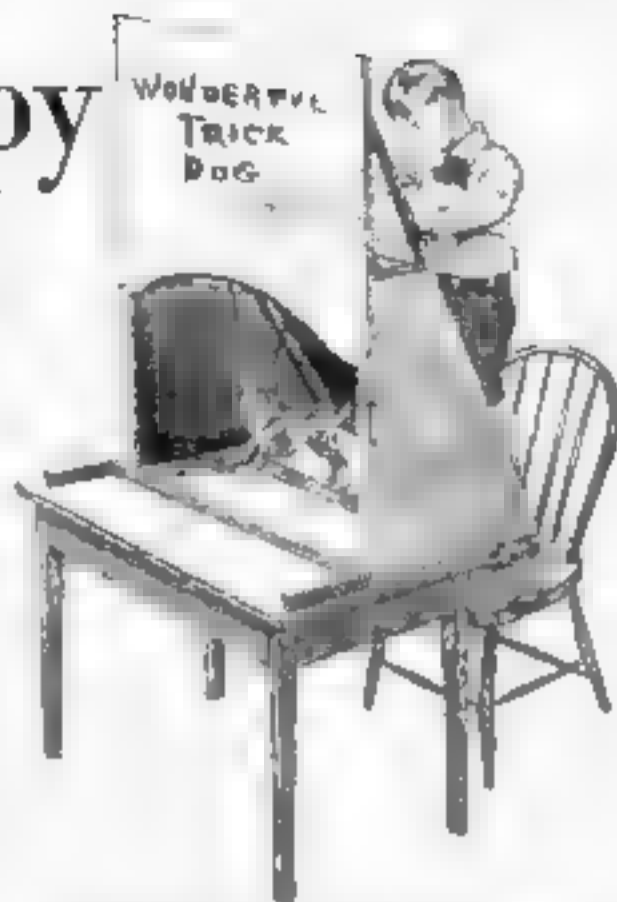


Fig. 1. Animated dog show given in a tiny theater that conceals the operator.

location gives the head the best balance. For the body a thread is used on each side of the shoulders and one at the rump.

By moving the head controller forward with a rocking motion you can give the puppy the appearance of prancing along. In the meantime the head can be moved from side to side and up and down to give a frisky action. The tail wags itself.

With practice you can make this lively

IN EVERY neighborhood there is a puppy. Even if he isn't your own puppy and doesn't bury his bones in your garden, you find his antics amusing. By making a wooden copy of him—a puppy puppet—and burlesquing his tricks, you will have a lot of fun.

This animated little dog (Figs. 1 and 2) is made from a block of white pine $1\frac{1}{4}$ in. thick, a piece of the same wood $\frac{1}{4}$ in. thick, and two coil tension springs about $\frac{1}{2}$ in. in diameter (similar to those used on light screen doors). You will also need some small nails, cloth, black ink, and a small jar of show-card white.

Lay out on paper a plan with 1-in.

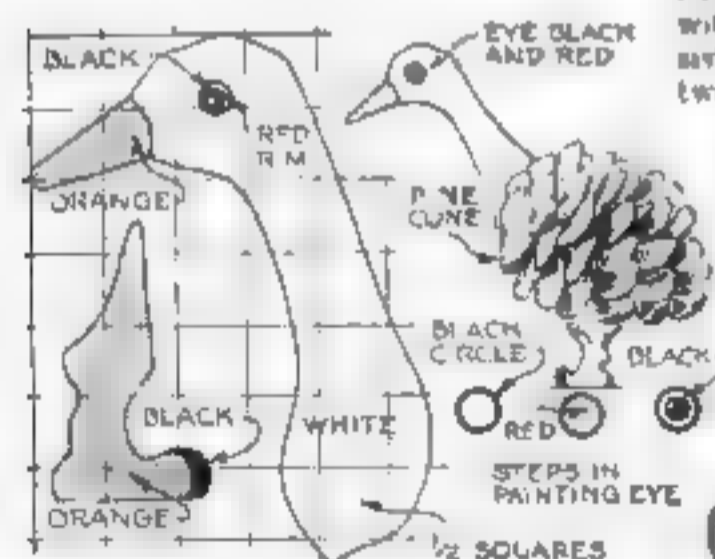


Fig. 3. Amusing toy goose composed of a pine-cone body and wooden head and legs.

squares as shown. Sketch in outlines of head, body, and legs; transfer these to the wood, and rough out the various shapes with keyhole or coping saw. The block for the body should be tapered toward the hips. Round the corners, particularly at the beginning of the neck. The head also should have a pronounced taper toward the muzzle and be rounded at the crown.

Cut an oval piece from the $\frac{1}{4}$ -in. wood

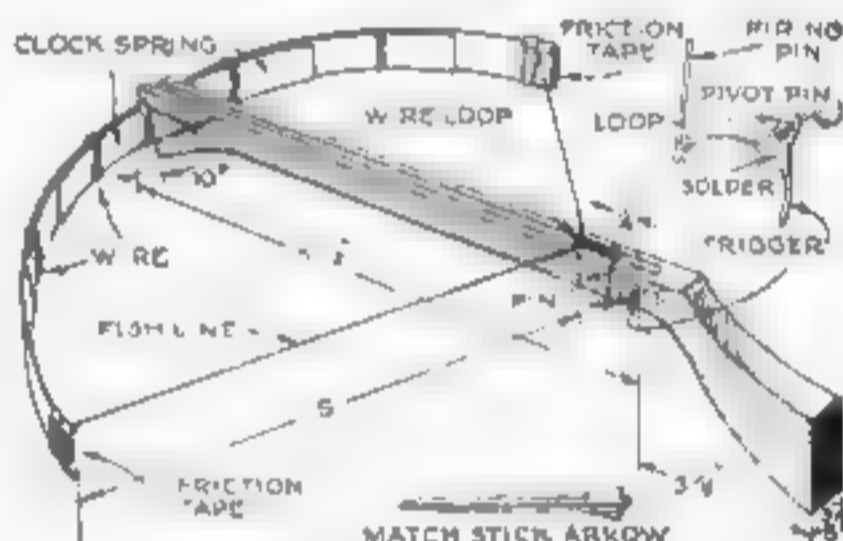


Fig. 6. Tiny crossbow for shooting match-stick arrows. The stock is whittled from wood; the bow is a steel spring.

little puppy do all sorts of tricks, such as jumping over cigar boxes, standing up and begging for food, and walking on his hind legs. Greater action can be obtained by attaching strings to his front knees (use tacks or cigar-box nails) and carrying them up to the long member of the controller at each side of the peg at the front end. These can be worked individually with the fingers, causing the dog to offer his paw in saluting.

The advantage of this puppet is that it requires no conversation to go with the action, though, of course, anyone can simulate a bark, whine, or squeal to add to the entertainment. H. H. HILARY

FOR making the pine-cone goose of Fig. 3, cut from $\frac{1}{4}$ -in. soft pine two legs and a neck and head. Use the $\frac{1}{4}$ -in. squares to aid in the enlargement. (Continued on page 129)



New skill for amateur hands through Stanley Plans—only 10c each

YOU have a mechanical "turn" or you wouldn't be reading this magazine. But have you ever really experienced the pleasure of making things with tools and wood? You can make articles like the above at little cost. Thousands are now using Stanley Plans and are enjoying a useful hobby as well as the pleasantest one of them all!

There are 25 different Stanley Plans. The list is shown in the center of this page. Each plan covering every step, tells you just how to make the object—

Here is the complete list
of Stanley Plans
No.

- 1c—Book Rack
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- 7c—Sawce
- 8c—Dinner Gong
- 9c—Bird Houses
- 10c—Dog House
- 11c—Book Stand
- 12c—Smoking Cabinet
- 13c—Kitchen Cabinet
- 14c—Sewing Cabinet
- 15c—Cedar Chest
- 16c—End Table
- 17c—Tea Wagon
- 18c—Model Sailboat
- 19c—Flat Bottom Rowboat
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Seat and Step Ladder
- 21c—Garden Seat
- 22c—Garden Trellises
- 23c—Small Tool Chest
- 24c—Large Tool Chest
- 25c—Work Bench

how to select and cut the wood, how to assemble the job, how to sandpaper, paint and finish it.

To do your best work you need good tools—of course! Practically every carpenter uses Stanley Tools. Manual training classes, too. Stanley makes the most complete line.

Buy your Stanley Plans from your hardware dealer. If he cannot supply you, write to us. Send 10c for each plan and ask for a free catalog of Stanley Tools. Address Advertising Department, The Stanley Works, New Britain, Conn.

The best tools are
the cheapest to use



Ask your
hardware dealer

STANLEY TOOLS

The choice of most carpenters

Tiny Monoplane Flies Indoors

Gives New Thrill Even to Experienced Model Makers—Of Advanced, Featherweight Design, Yet Not Hard to Build

PICTURE a tiny tractor monoplane flying very slowly, no faster than a person normally walks. Its large propeller revolves so slowly one can almost count the turns. On it floats, mounting higher and higher. It seems it will not run down. You have time to observe every flying characteristic, as if watching a slow-motion picture of an airplane fight or looking at some strange, slow-moving bug under a microscope.

The indoor endurance tractor is stripped of every unnecessary fraction of an ounce of weight. It has only a stick to hold the motor, a wing to support it, a tail to stabilize it, and a propeller to pull it. There is no undercarriage. The tiny ship is so light it can land with perfect safety on its propeller, which is, indeed, the heaviest part.

The parts are very delicate, but if you work carefully you can build a model which, despite its light weight, will stand the shock of collisions.

The model can be made of either white pine or balsa. Make your first model of white pine. You will find the experience valuable afterwards in constructing an advanced model of wonderfully light but



When tested by Mr. Bunch on a perfectly still day, one of the models with white pine parts flew 2,100 ft., another of balsa wood instead of pine construction went 3,000 ft.

frail balsa wood. The latter is the kind of model with which world records are made.

Constructing these indoor models will open a new field of experimenting for many who have built previous models in the POPULAR SCIENCE



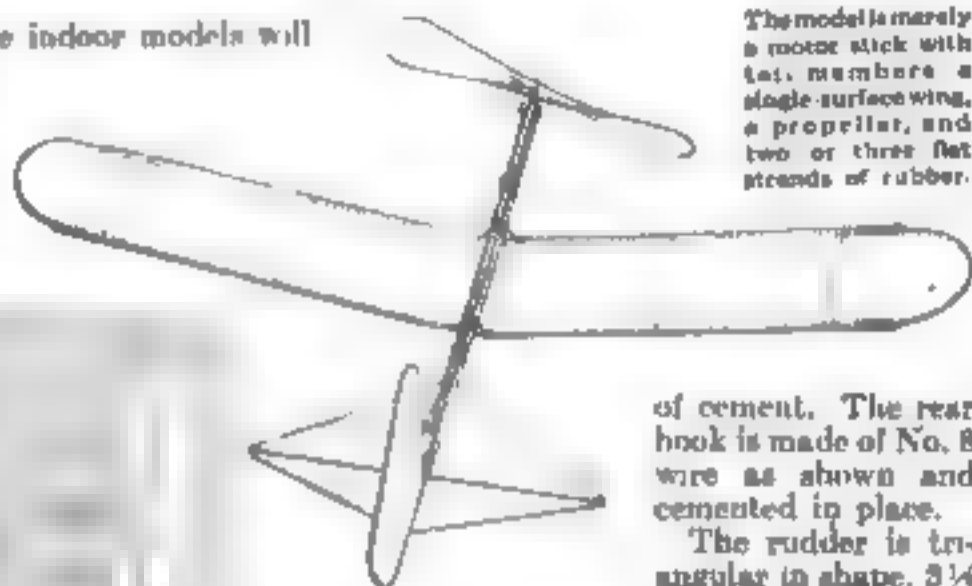
By

J. DANNER BUNCH
and AVISON F. KOCH

MONTHLY series. Someone, by careful workmanship and perhaps with a few ideas of his own, may beat the duration record, which, at this writing, is only a few seconds less than three minutes. It's worth trying for.

The fuselage is white pine, light and straight-grained, $\frac{3}{8}$ by $\frac{1}{2}$ by 14 in. It should be sanded smooth and have the corners slightly rounded.

Make the propeller hanger of No. 8 piano wire. Bend a tight loop in the wire, next bend the wire downward and rearward $\frac{1}{2}$ in., then parallel to the fuselage for $\frac{1}{2}$ in. The hanger should hold the propeller shaft $\frac{1}{4}$ in. above the fuselage. The hanger is bound to the top side of the front end of the fuselage with about ten wraps of silk thread and cemented, preferably with an ambroid type



The model is merely a motor stick with tail members, a single-surface wing, a propeller, and two or three flat strands of rubber.

of cement. The rear hook is made of No. 8 wire as shown and cemented in place.

The rudder is triangular in shape, $3\frac{1}{4}$ in. long and $3\frac{1}{4}$ in. high. The rudder outline is bamboo, $\frac{1}{2}$ by $\frac{1}{2}$ in. It is a good plan to draw the rudder out full size and bend the bamboo over a candle flame to that shape. Extend the bottom side of the outline $\frac{1}{4}$ in. and bind and cement it to the bottom edge of the fuselage. The top of the same binding holds the rear hook. Before binding the outline in place, cut a notch in the bottom edge of the fuselage for the tail spar.

The tail spar is bamboo $\frac{1}{2}$ by $\frac{1}{2}$ by 8 in. Slip it into the notch and cement it. Also cement the vertical side of the rudder to the end of the fuselage. Be sure these are true and then allow the cement to set without disturbing the parts.

To complete the tail, stretch a silk thread around it as shown, and tie it to the rudder outline $1\frac{1}{4}$ in. to the rear of the fuselage. Pass the thread around the end of the tail spar and secure in a slit on the bottom of (Continued on page 188)



Side, top, and front views of the indoor endurance tractor, and details of the covering at the wing tips; the propeller, shaft and hanger; the S-hook, rear hook, wing clips and "ears."

Ready for use
in a
minute and a half!
—and that's only
part of the story

YOU'RE going to get a real kick out of it—the first time you light up one of these new Clayton & Lambert fire-pots. No hanging around waiting for it to warm up—ready for business in a minute and a half in any weather. Cold and wind make no difference. Clayton & Lambert took care of that in designing these new fire-pots.

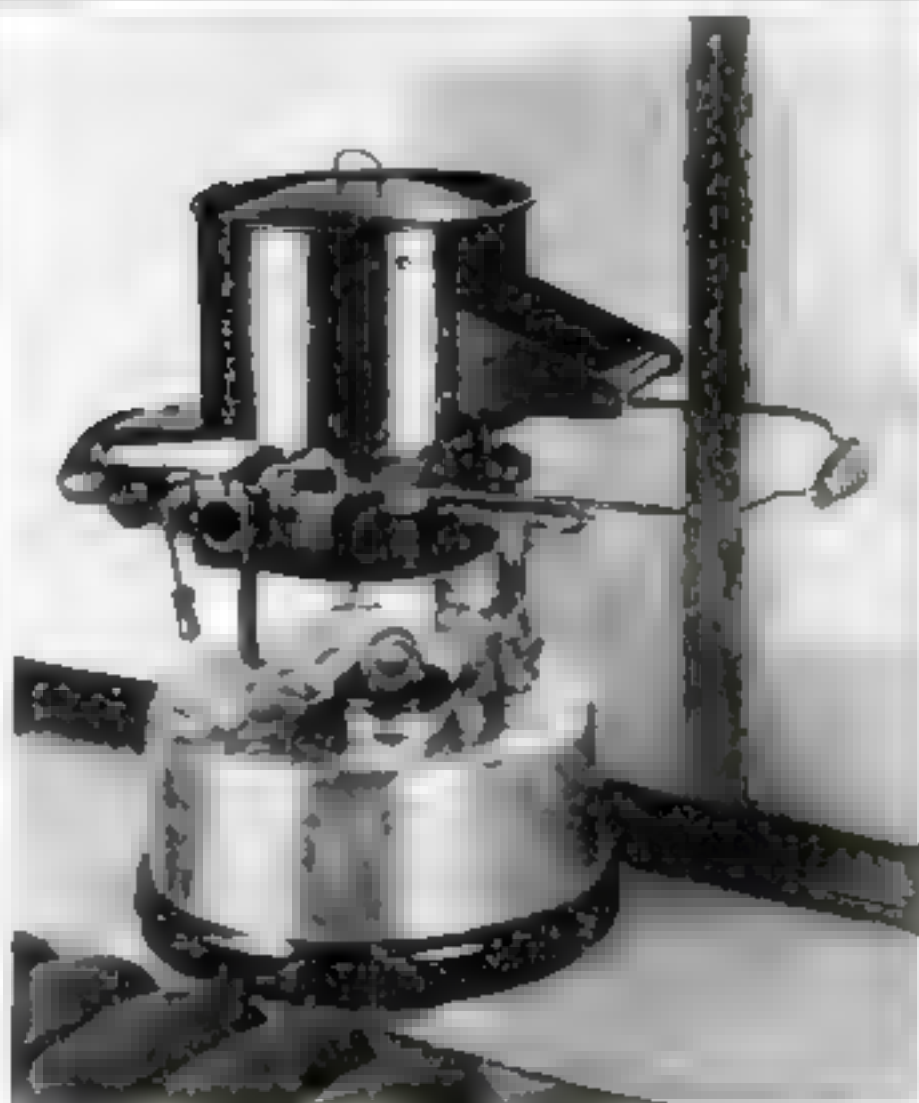
And after you get that hot, blue flame you can control it as easily as a lamp. Turn it up or down, just where you want it. *There's* a chance to save a lot of fuel.

You can use it on inside jobs without annoying anybody—it's noiseless, odorless and smokeless. If you have to haul it around a lot, you'll appreciate its lighter weight before the day's over. And the rougher the work the more you'll be thankful for that husky red rim around the base which protects the tank from denting and leaking.



CLAYTON
&
LAMBERT
MANUFACTURING CO.
DETROIT, MICHIGAN

This is the Clayton & Lambert No. 70 fire-pot with tinner's hood. Produces a working flame in ninety seconds. Flame controlled as easily as a lamp. The burner orifice cannot be enlarged by tightening the needle valve. No chance of ruining the fire-pot that way—that's an exclusive C & L feature. Will heat a pair of soldering coppers and melt a pot of metal at the same time.



Either of the two Clayton & Lambert fire-pots shown on this page will burn at full capacity for six hours on a single filling, which means you can stay right with your job instead of chasing up more fuel and letting your metal go cold.

Most hardware and supply stores sell these Clayton & Lambert fire-pots. You can identify them by the bright, red band around the base of the fuel tank. If they don't have them in stock they can get them for you quickly. And you'll certainly be well repaid for being particular and asking for them by name. For the performance of Clayton & Lambert products has made this company the largest producer of fire-pots and blow-torches in the world, giving you quality articles at the savings permitted by quantity production.



This is the Clayton & Lambert No. 60 fire-pot with plumber's shield. Tank capacity one gallon of gasoline. Burns six hours full capacity without refilling. The shield can be detached, and the handle locked, so that coppers can easily be heated.

Internal Grinding

Equipment Needed — Faceplate for Truing Long Work Typical Set-Ups

By HECTOR J. CHAMBERLAND



INTERNAL grinding in the up-to-date shop is a daily problem. To do it properly requires attention and practice on the part of the machinist or toolmaker. And the equipment must be in fairly good condition.

A four-jaw chuck, a faceplate, and, above all, a good internal attachment or spindle, are the most necessary and important items of equipment.

The four-jaw chuck is given preference in the tool room on account of its convenience in truing up cylindrical or square work. The faceplate is used for pieces which, on account of size or shape, cannot be held in the chuck.

The spindle should be of the quill, ball bearing type if possible, because of its sturdy construction and because it elim-



The first secret of success in doing accurate internal grinding is to use a properly adjusted spindle.

inates any possible springing action. If other types are used, they should be inspected often and taken up for wear when necessary.

The outcome of an internal grinding job depends on the spindle. A ground hole nears perfection only to the degree made possible by the combined wheel and spindle. Skill cannot overcome serious spindle defects.

The finish on the work is an important factor, it is a question whether the job is for a press or drive fit, or a running fit. A hole ground with a wheel dressed with a manufactured abrasive, for example, and one ground with a wheel dressed with the diamond, have a very different appearance if magnified only several times. The diamond leaves the necessary square and smooth finish on the wheel and should be used whenever possible.

THE finish is not so important when the piece being ground is for a drive fit. On the other hand, for a running fit finish the wheel should be freshly dressed before removing the last .002 in. stock on the work and the last .001 in. should be ground off by feeding no more than .0001 in. each time across.

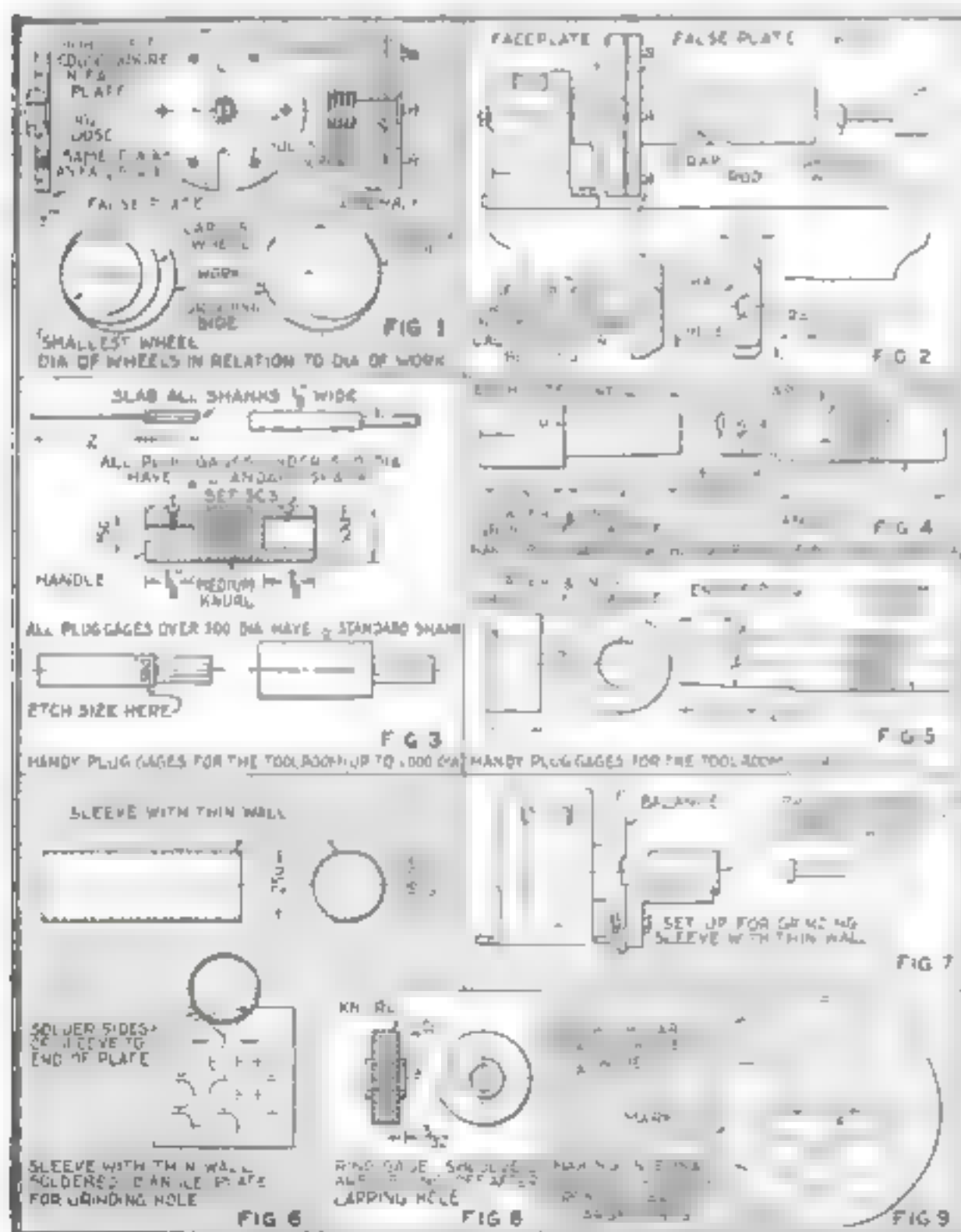
While grinding the wheel never should project beyond either end of the work more than half its width. This will prevent bell-mouthing.

The diameter of the wheel should not be less than three quarters and not more than seven eighths the diameter of the hole. This is important for two reasons: if the wheel is too small, it will not stand up on a much larger surface; if too large, it will have a tendency to heat the work. In both cases the finish is likely to be unsatisfactory. The traverse speed of the wheel should be correspondingly in accordance with the revolving speed of the work.

Do not force the wheel even when roughing out work. Care in this respect will help in getting a good finish and a perfectly round hole.

To find out if a hole is being ground straight, it is necessary only to work the wheel to the opposite side of the hole, this test will show if the hole is straight or if it is large in the front or in the back.

For tapering holes it is important that the wheel should grind perfectly central to the work. *(Continued on page 131)*



Combination faceplate (Fig. 1) and how it is used (Fig. 3); plug gages (Figs. 4, 5, and 6); set-up for thin bushings (Figs. 6 and 7); ring gage (Fig. 8), and a way to salvage worn wheels (Fig. 9).



Actual photograph of the home workshop of Mr. Fred Bailey

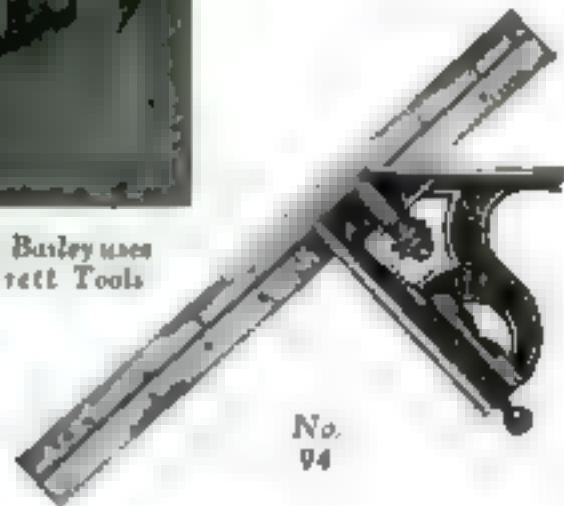
Lexington, Mass. Mr. Bailey uses these and other Starrett Tools



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The first thing every man or boy who owns, or plans to own, a home workshop needs is the big, new Starrett Catalog fully describing and illustrating all of the fine precision tools for workers in wood or metal, whether professional or amateur.

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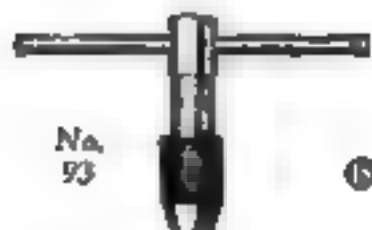
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No. 320-K

Use Starrett Tools

Spotting, Sawing, Stamping

Three Kinks to Save Your Time in Solving Daily Shop Problems

MUCH work in which holes have to be related correctly to each other requires the locating to be done within perhaps two thousandths. While work of this kind can be done by precision methods—with buttons or with blocks and parallels—these procedures are slow, especially where there are a number of holes. To spot such work with scratch awl, square, and center punch and get it right, requires extreme care and has the disadvantage that it is difficult to verify the location until after the boring itself—and quite often the damage—

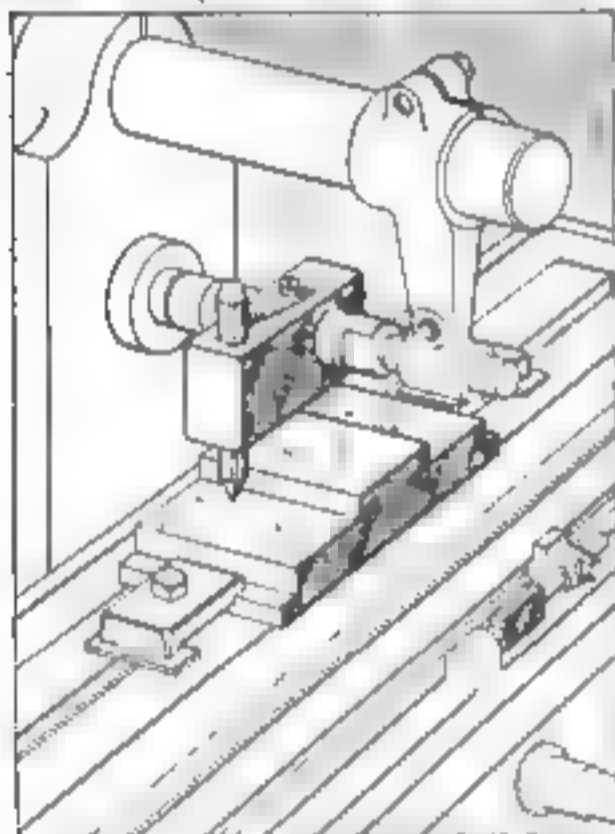


Fig. 1 Spotting attachment on milling machine for laying out work quickly and with reasonable accuracy.

has been done.

In Fig. 1 is shown a simple device that can be made at practically no cost except some odd moments of time, and by which the man in even the smallest shop will be enabled to lay out and spot many kinds of work so that it can be bored or drilled true within from .002 to .001 in. and sometimes even less. And the locating can be done so quickly that compared to some of the other methods it will look like "no time."

The bore for the punch is relieved centrally so as to give a bearing only at the ends. The punch should be a snug sliding fit, with not more than .0002 in.

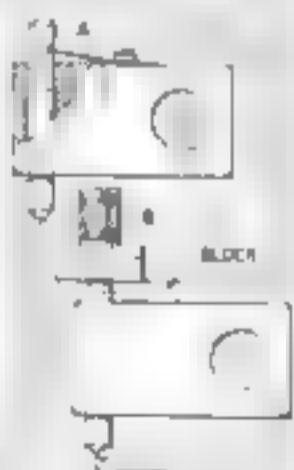


Fig. 2. The attachment with a plain punch, A, and with a revolving cutter, B.

GOING to and from your work is a good time to figure out that next job. To plan for a few moments sometimes saves hours of work. Remember that a good employee makes a good employer.

Turning, filing, "emerying"—as well as center friction heat up work on centers. A good mechanic allows the work to get reasonably cool before the final "miking" to size. If this is done, the work is not likely to be undersize. Heat will expand metal.

When you cut a keyway in a pulley or a gear that has spokes, always locate the keyway on the center line of a spoke.

A properly ground milling cutter should have a land about one sixteenth inch wide. The angle may



Old Bill Says—

vary from four to six degrees, the first for steel and the last for cast iron. The relief or clearance angle back of the land should be about twelve degrees, but not more.

If you have any difficulty when cutting threads on steel, try a mixture of oil and sulphur on the work.

Ideas and suggestions are useful only when they are put to work.

A good thing for the beginner to remember is always to use calipers first on a piece of work. It is easy to get the work twenty-five thousandths over or under size—that is, one turn of the "mike" spindle.

An adjustable light bracket should not be attached directly to a machine; arrange a floor stand for it or fix it to the wall.

"shake." It is best to use a punch that is ground all over. A shallow notch under the head receives the end of a light leaf spring, which normally holds the punch in the raised position.

Figure 1 shows the spotting device in use on a plain hand-milling machine, where it is held on the spindle as a cutter would be. The spindle is locked against rotation by a block of wood lightly wedged between the pulley and overarm. By using the dial on the cross feed, and size blocks or length gages between the movable and fixed stops on the longitudinal feed, the machinist or toolmaker can lay out any combination within the range of the machine.

It goes without saying, of course, that the work done with this device can be no better than the machine on which it is used. Most modern machine tools, however, have a considerable degree of accuracy in regard to the traversing movements; and unless badly worn, the slide and table are likely to move in practically a straight line and at right angles to each

other. A trial made with several locations on a test plate will show what the error is.

At B, Fig. 2, is illustrated the same attachment fitted with a revolving cutter that permits the spotting to be done with-

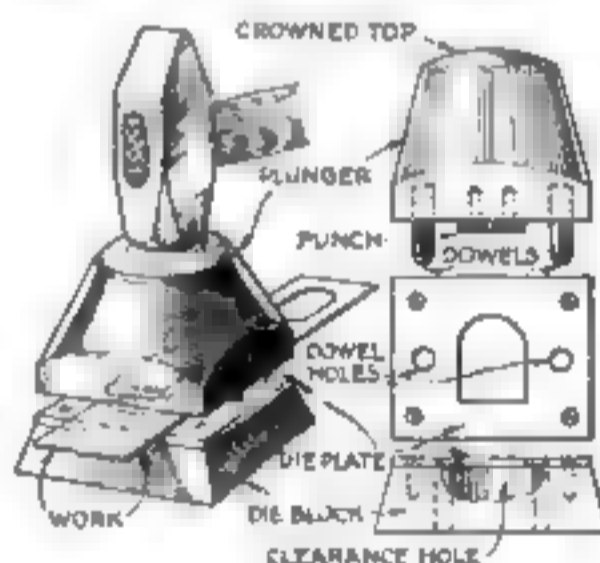


Fig. 4. Hand operated punch and die for stamping small parts without a press.

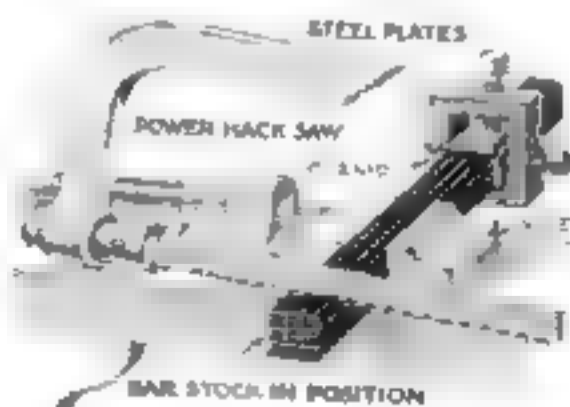
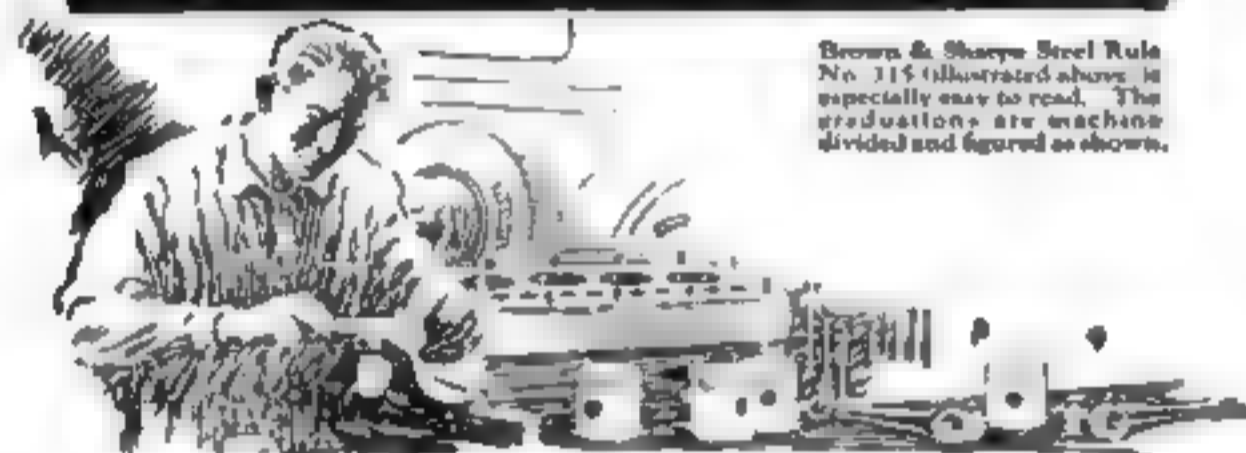
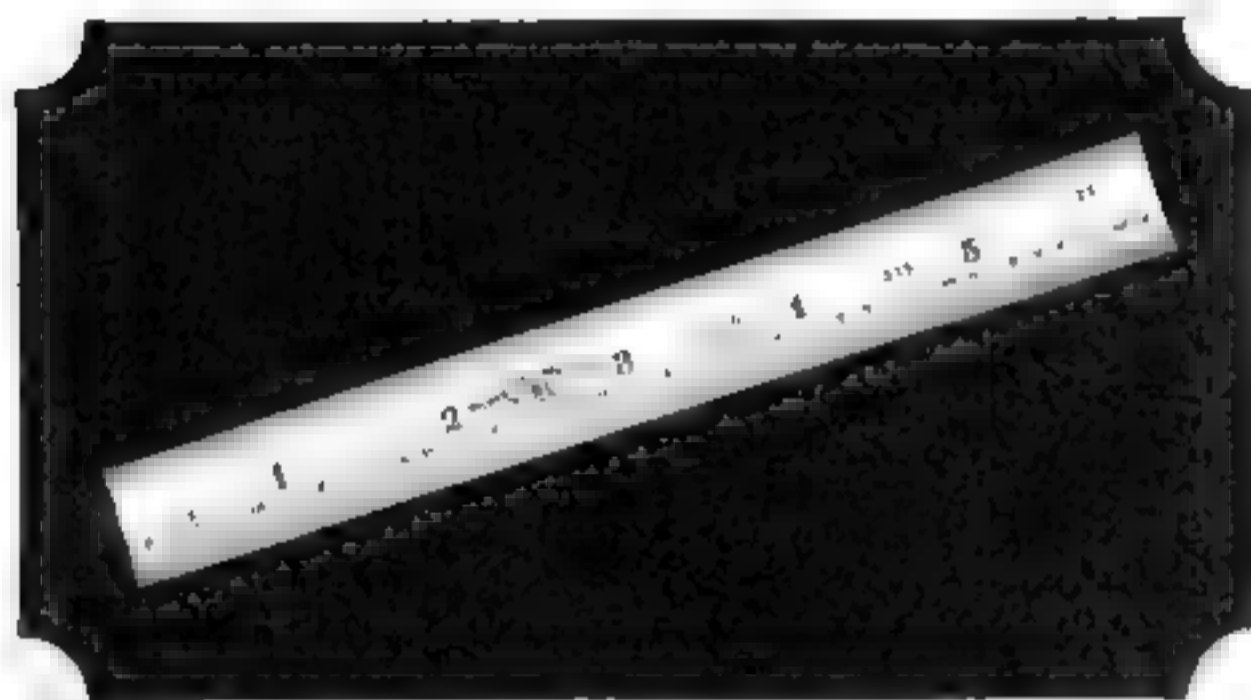


Fig. 3. A clamp to expedite the cutting of a number of pieces of bar stock at one time.

out any jarring and without causing any compression and consequent distortion of the metal such as might be troublesome in thin work having closely-spaced locations. The cutter is nothing more than a center punch of which the point has been carefully "halved off" and sharpened. It is spun with the fingers by means of the knurled handle, which is lightly driven in place on it and serves simultaneously as weight and "flywheel." A steel block slipped under the flange keeps the spindle raised when not in use.

Where the stationary stop on the cross slide of the miller (Continued on page 128)

Use Good Tools For Every Job



Brown & Sharpe Steel Rule No. 315 (illustrated above) is especially easy to read. The graduations are machine divided and figured as shown.

For the commonplace measuring jobs as well as those requiring extremely fine measurements, use good tools. The Brown & Sharpe line includes not only precision tools for the most exacting work, but many such general tools as the rule shown above, excellently made and handy for many mechanical jobs.

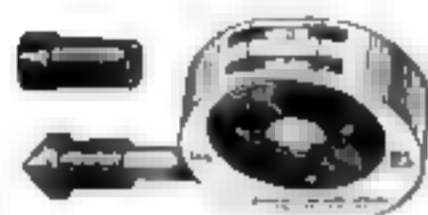
Consistent use of these high grade, well made tools will serve to keep up the quality of your work. Complete Brown & Sharpe tool equipment is a stimulus to do all your work well.

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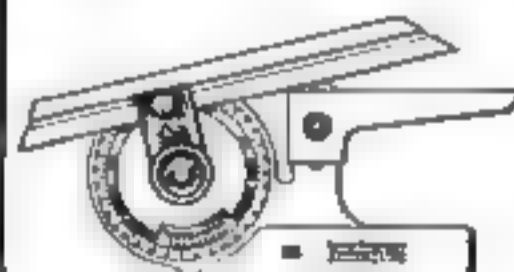
* TWIST DRILL AND STEEL
WIRE GAUGE
No. 709



* RULE DEPTH GAUGE
No. 615



* AUTOMATIC CENTER PUNCH
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* UNIVERSAL
BEVEL PROTRACTOR
No. 496

*A description of this tool appears in Catalog No. 30



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THE HANDY MAN



By GILBERT P. SYMONS

DO YOU know what? I wish the State Board of Education would empower me to hand out the degree of H. M. In England they might think it meant "His Majesty" but here in America it means "Handy Man."

Remember, A. B. stands not only for Bachelor of Arts, but also for Able Seaman. The Able Seaman may be dying out, but the Handy Man, never! I would find him everywhere, in almost every walk of life, but especially in the little home paid for (or being paid for, through the Building and Loan Association).

The supper dishes have been washed and Mother is about to switch out the kitchen light, when she says: "Poppa, you better buy us a new clock tomorrow. Our old one stopped today. I wound it and shook it, and it just wouldn't go. A gleam comes into Poppa's eyes—a gleam of sport ahead. It isn't the sport of paying out \$2.75 for a new "Good Morning" from New Haven, Conn. No sir! That's a good clock, if only women knew how to treat a clock.

The women go into the living room and Pop has the kitchen to himself. Has he got everything? His reading glasses, a feather, benzine bottle, tweezers, fine screw driver, and some saucers? All right! Off with coat and vest and let's sit down to the nice enamel-top kitchen table and find out what's wrong. Let's draw "Good Morning" out of his nickel shell. Aha! Kitchen grease and fluff on the pallets of the escapement—two years of kitchen vapor. Benzine on the feather fixes that. Might as well touch up the ends of all the train arbors while we are at it.

Look again. Mother said she shook the clock hard. She certainly did, for she shook the staff of the balance wheel clear out of its seating! Now easy with the tweezers and don't strain the hair spring. A soft sound, not so hard as "snap," and then the little balance wheel is going again like sixty. Little drop of watch oil now, just for affection, on the end of a hatpin (these days Poppa has hatpins in his toolbox, now that the girls don't use them).

"Good Morning" they called you, and the way you are going, old clock, it will be some time before we call you "Good Night."

Just then I step in on behalf of the Board of Education and view the whole works. But more, I view the man. He is glowing with pride. He had rescued something good from the ash barrel. "Man," I say, "Man, you're a wonder. You're not only a Good Man; you're a Handy Man. This diploma that I am awarding to you says so."

Or I spy the village doctor some evening down in the laundry peering into a wash boiler. "What is it, doctor?" I ask. "Home brew?" "No, sir," he says. "As fine a piece of plastic surgery as ever I saw. The cook punched the wash stick clean through that copper bottom last week. She said the old wash boiler had sprung a leak! Didn't seem to realize that the grill top of a gas stove doesn't give much resistance to punching sticks.

What do you think of my soldering? I patched it with a penny and no disrespect to Abraham Lincoln, either."

"Honest Abe would love you, doctor. Here's another diploma: H. M.—Handy Man." (Continued on page 110)



IF YOU LOOK

OR IF YOU LISTEN



RADIO QUALITY —that means Years of Pleasure/

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Table model \$150 without tubes and speaker. With speaker table \$205. Console \$295, without tubes. (Higher in Far West.)

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THE final polish is given by rubbing the oil into the wood with a soft cloth.



Oil Rubbing Old Furniture

How to Give Antiques a Glowing Luster—Darkening New Patches—Hints on Waxing

By R. C. STANLEY, *Expert Furniture Restorer*

WHEN all the necessary patching and repairing have been done to a piece of antique furniture and the old finish has been removed as suggested in the first of these articles (December, 1927), we are ready to refinish the piece.

You may wonder why the removal of the old finish should be delayed until after the patching has been done. That is because I have found it bad practice to wash off surplus glue from newly made joints. If the gluing is done before the old finish is removed, the surplus glue comes off with the old finish. If the finish were removed first, the surplus glue would have to be scraped off, and the scraping would mar the surfaces.

My experience has been that genuine boiled linseed oil is the best agent for giving a deep, lustrous appearance to old wood. Brush the oil out thin so as to apply no more than will be absorbed by the wood. The oil will require from twenty-four to seventy-two hours to dry thoroughly, the time varying with the temperature.

There are a number of opinions as to how linseed oil should be applied—whether full strength or diluted, whether boiled or raw. A very hard wood will not absorb as much oil as a softer one, so it is well to examine the wood and dilute the oil enough so that all will be absorbed. My practice is to use one part boiled oil and one part turpentine for all wood, but to apply more than one coat if the first coat sinks in so that it is clear the wood will absorb more. If too much oil is applied, the surplus will dry on the surface and must be removed with steel wool—a very tedious and annoying job.

The accepted method for refinishing

antique furniture is to leave it in the natural wood, that is, to polish the wood without the use of stains or varnish. If this finish is desired, allow the piece to stand a day after removing the old finish so that the varnish remover will evaporate entirely, then oil the wood and allow ample time for drying.

If the patches appear new and of a lighter color than the surrounding wood, there are a number of ways in which they may now be treated.

1. Make a paste of dehydrated lime and water, the consistency of thick cream. Apply this paste about 1/16 in. thick to the new wood, let it stand for a day, and remove it carefully with a scraper and steel wool. If the wood still does not look old enough, repeat the process.

2. Dilute nitric acid with an equal amount of water and apply with a fine brush or a small swab to the new wood. Allow a day for the action of the acid and then wash it off with alcohol. This method is convenient and is used by many, but I do not recommend it. The acid is dangerous in the hands of those who are not accustomed to using it, and, furthermore, it seems to me to give the wood an unnatural appearance.

3. Commercial wood dyes of the alcohol type, or spirit stains, as they are sometimes called, can be diluted with alcohol to the desired shade. These dye the wood a fast color and can be given a rubbed oil finish without difficulty.

4. There are also trade preparations, in fact, I use one exclusively and find it gives better results than the preceding methods.

When the new (Continued on page 131)

SAY GOODBYE to Hard Hand Drilling

A Complete Electric Workshop

including this $\frac{1}{4}$ " Drill
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Christmas shopping this year. With this power workshop you can make toys, magazine racks, light furniture, lamps . . . all sorts of wooden and light metal articles that will delight those you give them to.

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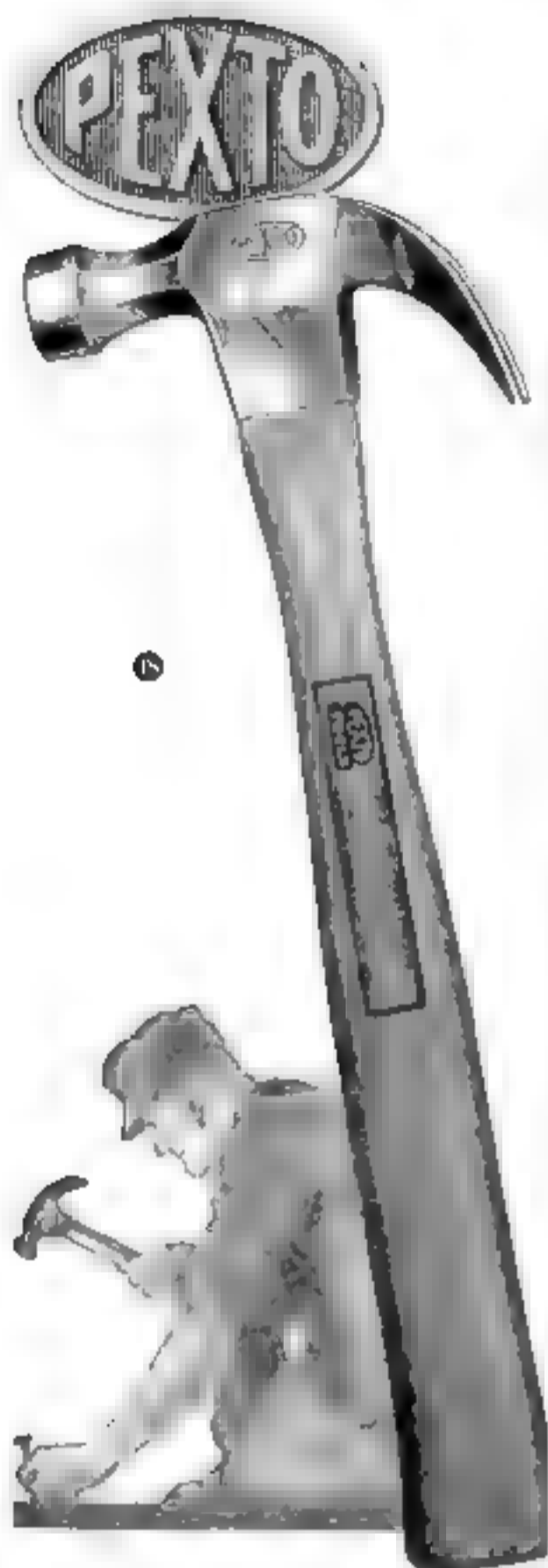
This drill will keep right on serving you long after many so-called "low-priced" electric drills have been retired to the scrap pile.

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Easy to Whittle but Will Amaze Your Friends

By ARTHUR L. SMITH

IN THE article describing the common six-block puzzle or "Chinese cross" in the May, 1927, issue, it was stated that the whittler could devise new combinations at will. Those who have tried to exhaust its possibilities have found the number running into the thousands without reaching the end. If this be true with six blocks, it follows that the number of different combinations with a greater number of blocks would be increased to an indefinite sum. For many whittlers the greater part of the pleasure of whittling the puzzles lies in devising the character of the cuts for themselves. There is no danger of describing all the combinations

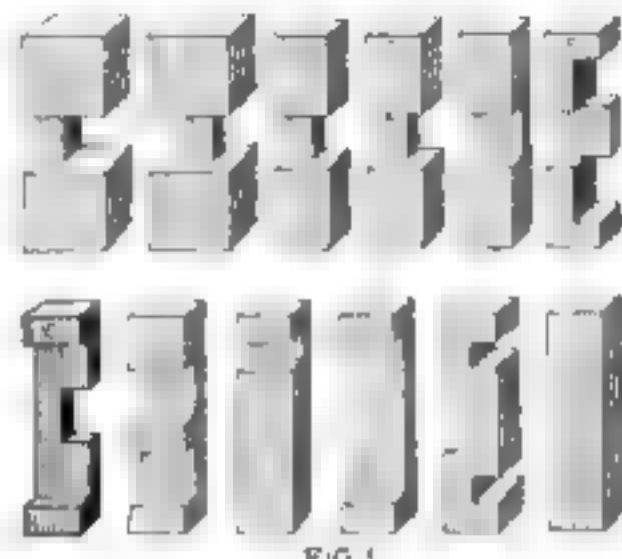


FIG. 1



FIG. 2



FIG. 3

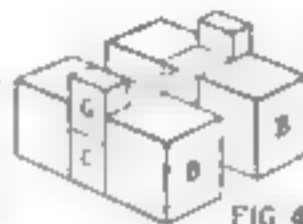


FIG. 4

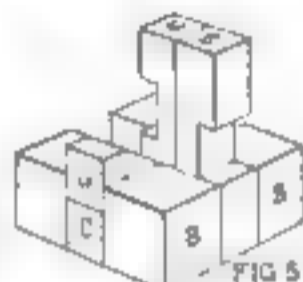


FIG. 5

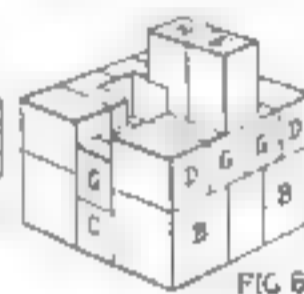


FIG. 6

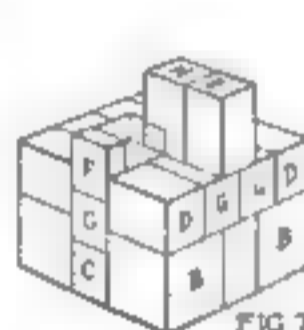


FIG. 7

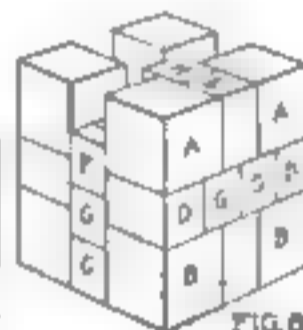


FIG. 8

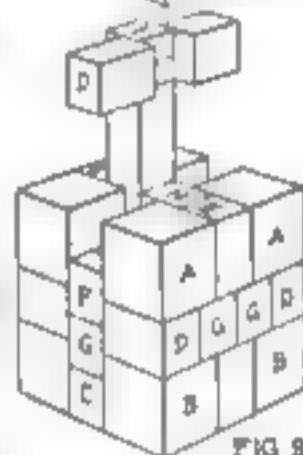


FIG. 9

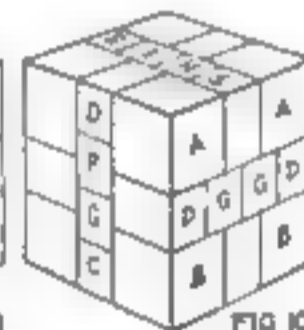


FIG. 10



FIG. 11

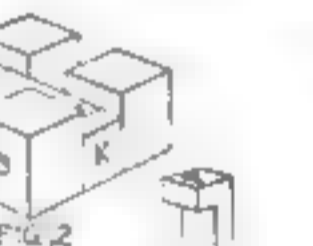


FIG. 12

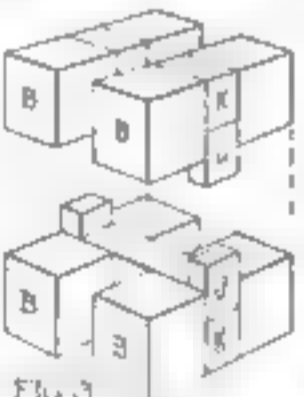


FIG. 13

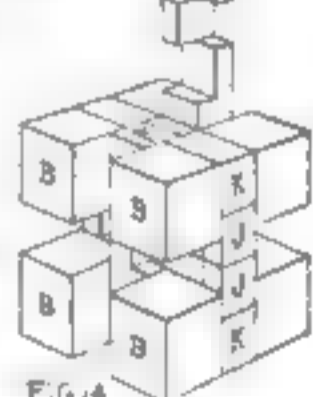


FIG. 14

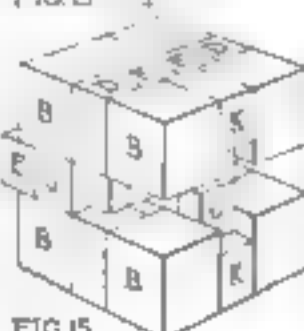


FIG. 15

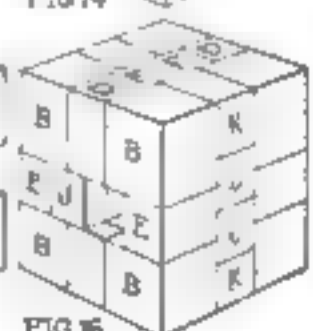


FIG. 16

How to cut and assemble the blocks. A and B are $\frac{3}{4}$ in. square; the others $\frac{1}{2}$ in. square.

so as to destroy this pleasure. These articles are intended to introduce readers unfamiliar with wooden puzzles to a new avenue of amusement.

In a former article (September, 1927) the problem was presented of combining blocks $\frac{1}{2}$ in. square by 2 in. long into the form of a cube. Ordinary cubical forms are composed of sixteen blocks of which four (A and B, Fig. 1) are $\frac{3}{4}$ in. square by 2 in. long and twelve $\frac{1}{2}$ in. square and the same length. Two ways of combining these will be shown. The second is but a variation of the sixteen-block puzzle described in a former article with the exception that four large blocks are substituted for four blocks marked C in that article.

Fig. 1 shows a series of blocks which will allow of at least two combinations in the cubical form. In all the blocks except A the cuts are uniformly $\frac{1}{4}$ in. deep and $\frac{1}{4}$ to $1\frac{1}{2}$ in. long. A has a cut $\frac{1}{2}$ in. deep.

The first combination requires the following sixteen blocks: A A B B C D D D E E F G G G H L. The illustrations show each step in assembling, the letters being placed on the ends in all cases. Block C is placed as shown in Fig. 2. B B are fitted into the $\frac{1}{4}$ -in. cuts (Fig. 3). Upon C the block G is (Continued on page 180)

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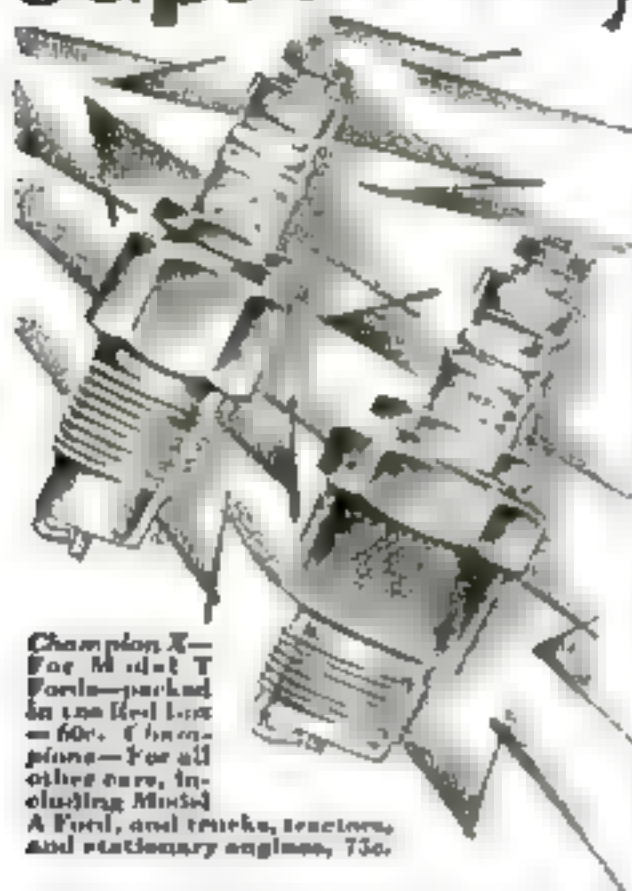
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TOLEDO, O.

How to Stop Window Leaks with Putty and Paint

By F. N. VANDERWALKER, *Noted Painting Authority*

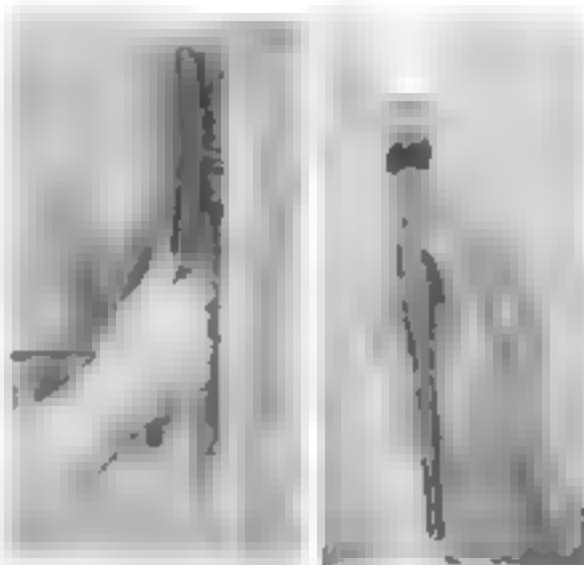


FIG. 1 (At left). Wire breaking a sash. FIG. 2 (At right). An oval sash brush.

ONE of the most annoying features about many a new home is the leaking of window sash. The casement windows so popular today are especially likely to let in water whenever there is a driving rain. Houses that have a very narrow roof overhang are often troubled because the rain beats directly upon the window glass. After the usual scramble for mops, sponges, and pails to check the flood before it runs the wall decorations, drapes, or floors, a few unkind words are said about the contractor.

The basic cause does, indeed, go back to the method of making the windows. They are of very dry wood, which absorbs the oil from the putty as if it were a sponge. If they are not given a coat of first-class oil paint before the glass is set and the putty put in place, the putty, even if of good quality itself, will not adhere properly for any length of time. As soon as it begins to crumble or break away, water naturally can penetrate through the window, and even if it does no especial damage inside, it will at least cause great damage to the paint and varnish inside and outside the sash.

Every specification for new window sash should require a coat of high grade oil paint before the glass is set, and also state that the putty be made from white lead, whiting, and pure linseed oil. Far too much putty is made from cheap pigments and oils, and far too many sashes are puttied after a skimpy coat of paint.

The very best glazing requires that the glass be bedded in putty—that is, after the sash bars have been painted and are dry, a ribbon of putty is run on the sash bars, the glass is put in place, the small triangular zinc glazing points are driven in, and then the outside putty is applied. A sash treated in this way with good putty and then well painted at intervals will never leak.

One inexpensive safeguard against leaks under the bottom of a casement sash is a small molding or drip cap. It throws the water away from the sash and onto the slanting sill.

When water runs in between the glass and sash bars of wooden window sash, examine the putty. If it is so dry and brittle that it is dropping out of place, the only economical remedy is to take out the sash one at a time and remove the old putty with a putty knife or an old wood chisel. If part of the putty is firmly attached and part cracked, it is possible on some jobs to remove merely the loose putty, then paint the wood and refill with good putty.

If all the putty is firmly attached but has pulled away from the glass in places allowing the water to run between, the remedy is to apply paint not only on the putty but also on the margin of the glass itself. That will, of course, make a messy-looking job, but the paint, if freely applied, will seal all the openings. At



Fig. 3. Failure to apply the proper first coat caused the scaling of this steel sash.

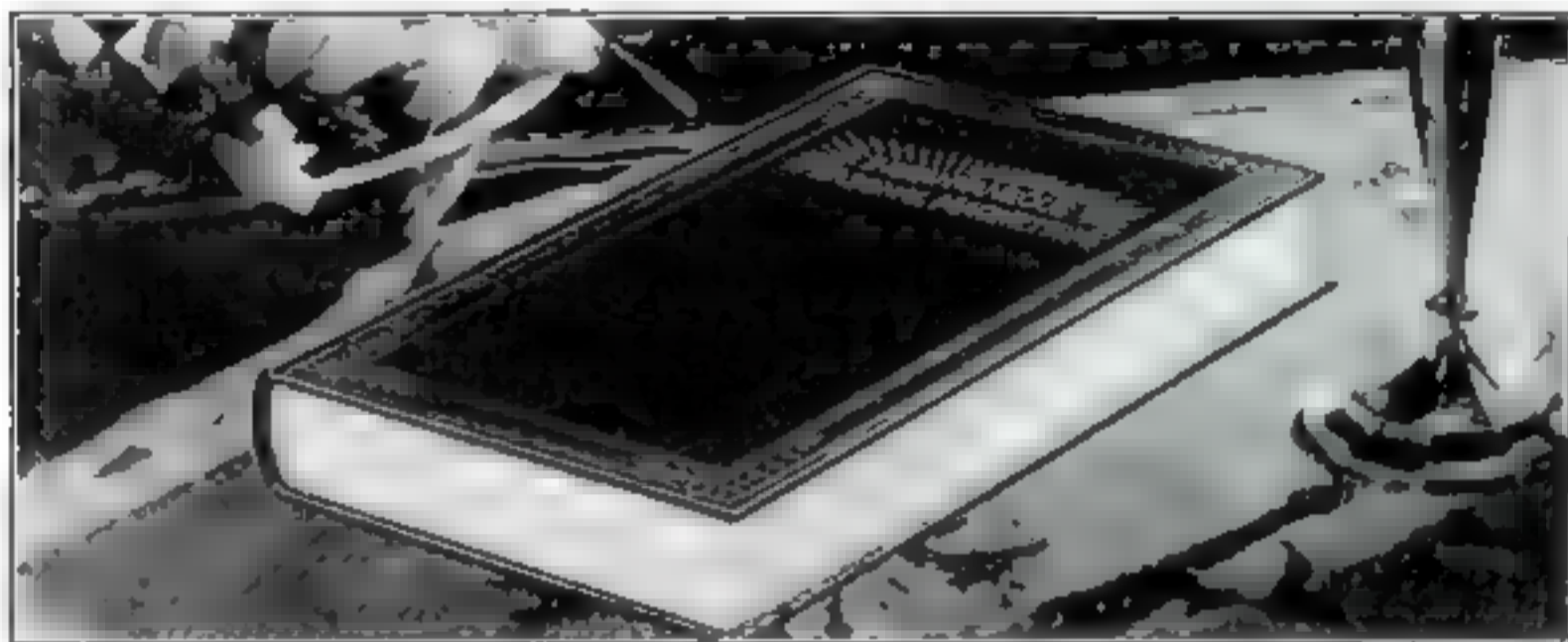
least two coats of good paint are required. When the paint has become hard, which requires at least a week's time, that on the glass can be readily removed with a safety razor blade held in one of the handles sold for this purpose (Fig. 4).

THE best putty is made from dry whiting, white lead, and pure linseed oil. There is so much cheap putty sold, adulterated with marble dust and inferior oils, that it pays to make your own. For colored putty, dry colors such as raw and burnt umber are added to the whiting and white lead.

The procedure is to place a pile of dry whiting on a pie plate or a board and work a lump of white lead-in-oil into it. Use a putty knife until the mixture is fairly dry and then knead it like bread dough. Pounding it with a club or a mallet is also a good way to mix it well. If it gets too dry, add a few drops of oil or floor varnish. *(Continued on page 110)*

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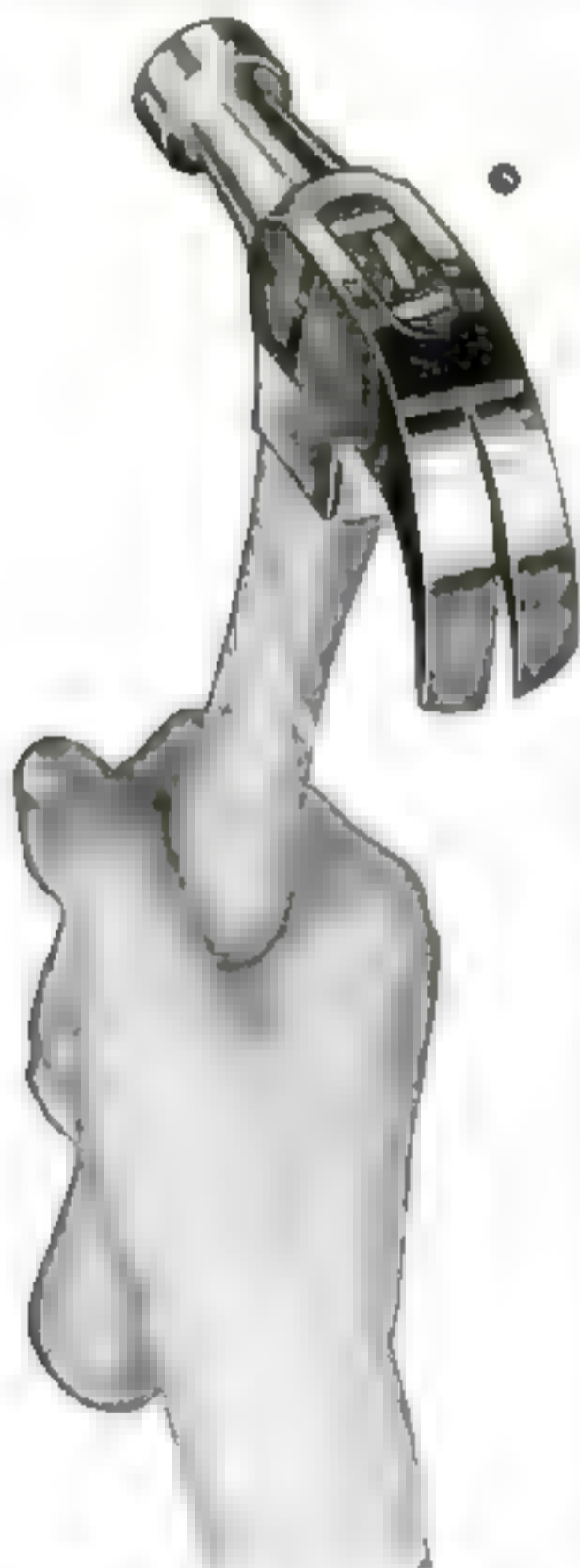
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Kite Carries Camera Aloft

Has 12-ft. Wing Spread and Looks Like Airplane—Releases a Parachute

By RUDOLPH F. FISCHER

ONE of the most interesting kites I have constructed during the four years that I have been building and flying kites as a hobby is the one illustrated. It has a wing spread of 12 ft., and the over-all height is 6 ft. An alarm clock fastened to the frame serves to release a 4-ft. parachute at any time for which the alarm clock may be set. The clock also can be used to operate a box camera, with which surprisingly clear "airplane" views can be taken.

In construction the kite is unusually substantial. I have flown it nearly fifty times and have never had to make repairs.

The four main body sticks and the two main wing sticks are $\frac{3}{4}$ by $\frac{1}{2}$ -in. basswood strips. Each long wing stick is composed of two 6-ft. lengths joined in the middle of the body with an aluminum sleeve. All other parts of the framework are $\frac{3}{8}$ -in. square basswood, nailed with 1-in. brads.

All joints are glued and wrapped with fine wire. Twine is used for the wing braces and 26-gage wire for the body braces.

The brace wires are attached to the body wherever required by means of $\frac{1}{8}$ by $\frac{3}{4}$ by 1-in. aluminum strips as shown on page 98. The wood is protected with two coats of varnish. The covering is blue silk tacked at 2-in. intervals with very small tacks.

The alarm clock mechanism—the casing and glass being removed to lessen the weight—is fastened with two $\frac{3}{4}$ -in.

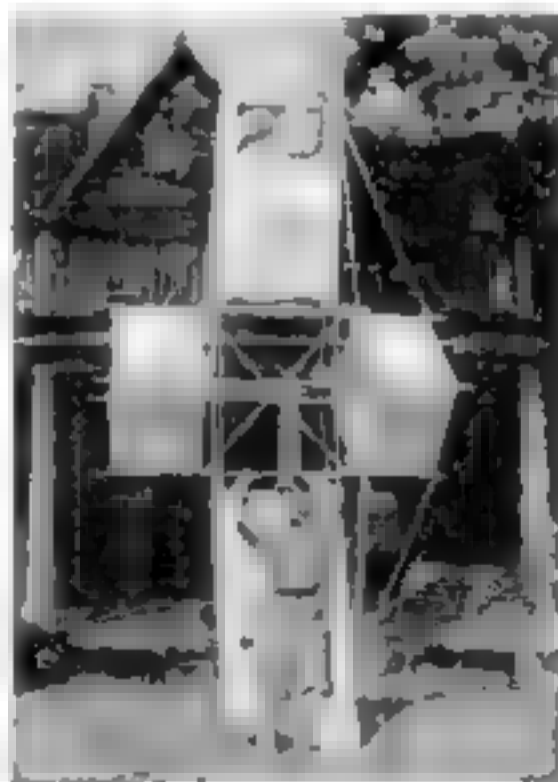
screws to a strip of wood $\frac{1}{4}$ in. square and 6 in. long, which is glued and wired to the kite frame.

The box camera is fastened to a strip, P, $\frac{3}{4}$ by $\frac{1}{2}$ by 8 in., by means of brass screws driven through the rear door of the camera. This strip is attached to the kite by setting the lower end in the aluminum socket G, the upper end is held by screw F. The camera is rigidly braced to the body of the kite by two braces of twine or wire as shown in the top view.

A SHORT piece of strong silk line is fastened to the alarm winding key J of the clock so that when the alarm goes off the key will wrap the line about itself, thus drawing the line through the $\frac{3}{4}$ -in. screw eyes I and operating the shutter lever of the camera by means of an auxiliary lever made as shown.

The line should be provided with small hooks at K so that the part of the line tied to the lever can be disconnected and rehooked to pull the shutter in the opposite direction.

The parachute is released by means of a pin made of wire $\frac{1}{8}$ in. in diameter and 2 in. long with an eye in one end. The pin slides through two $\frac{3}{4}$ -in. eyebolts. Between these eyebolts are two rings, one holding the parachute by means of a cord and two thin strips of bamboo, the other holding the parachute weight. As the clock pulls back the pin by means of a fine silk line, both rings are released and the para-



Close-up of the kite to show its structure and construction. A 25-lb. string is used.

(Continued on page 98)

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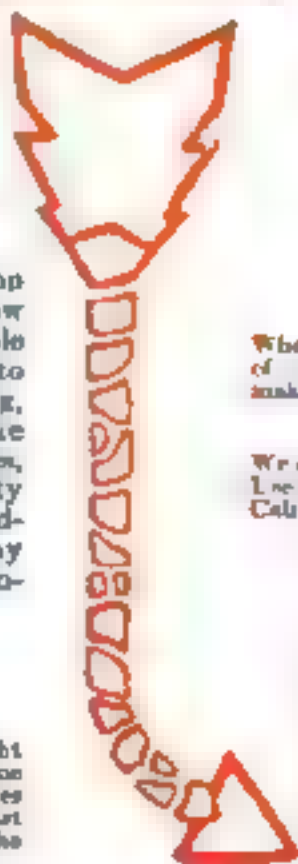
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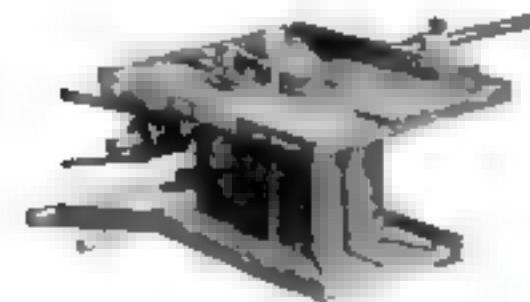
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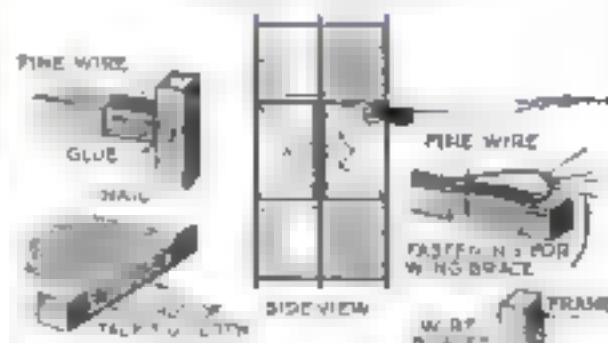
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Kite Carries Camera

(Continued from page 95)



Front and side views of the kite as it stands on the ground, details of the various fastenings

chute falls clear of the kite and opens.

The kite is held at three points, A, B, and C (front view). The lines are brought together at a snap swivel about 10 ft from the kite. The kite string, of 25-lb. twine, is fastened to the swivel.

I don't advise sending the parachute and clock up at the same time. Usually I set the alarm to go off about seven minutes after the kite leaves the ground.



Plan of the kite from above and the camera-operating and parachute-releasing fixtures.

White Lead Now Used for Mixing Plastic Paint

AMATEL R painters who mix their own house paints with white lead-in-oil paste can make plastic paint for textured walls and other decorative purposes by using the white lead as a base.

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The paint is applied over a priming coat or directly over old paint on plaster walls, if in good condition, and is brushed on in a thickness equal to about two coats of ordinary paint. It can be stippled with a brush or textured with a serving spoon, damp sponge, an ordinary kitchen rolling pin, or a trowel or other flat tool.

After it is thoroughly dry, it can be glazed by applying a coat of flattening oil, dabbing on spots of oil tinting colors, and blending them together with rags.



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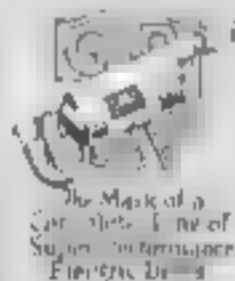
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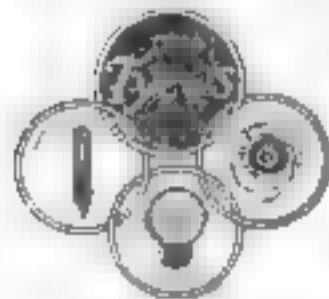
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Wooden Chucks Used in Turning Attractive Lamp and Stand

By HERMAN HJORTH



Fig. 1. Turned table lamp of a type any home worker can make on a wood lathe.

THE turned table lamp illustrated in Figs. 1 and 2 consists of two parts, the upright and the base. Before the upright can be turned, a hole must be made lengthwise through its center for the electric wires. This hole may be made either by boring through a solid piece of wood or by gluing two pieces together after first cutting a groove in each.

In the first method the advantage of having a solid piece of wood is offset by the difficulties encountered in boring the hole. The auger bit to be used should have a spur for end-wood boring, and, as the ordinary auger bit is not long enough, a hole must be bored from each end. If the ends are squared accurately with the sides and the holes started on a drill press, there is a good chance to have them meet in the center; moreover, any little unevenness may be readily removed by inserting a red-hot iron rod.

The only difficulty about the second method is to plane the faces of the two pieces accurately, so that they will make a perfect joint. A groove $\frac{1}{8}$ in. deep and $\frac{1}{4}$ in. wide should be cut in the center of each piece before gluing.

When turning the upright, block the hole in the end running on the live center

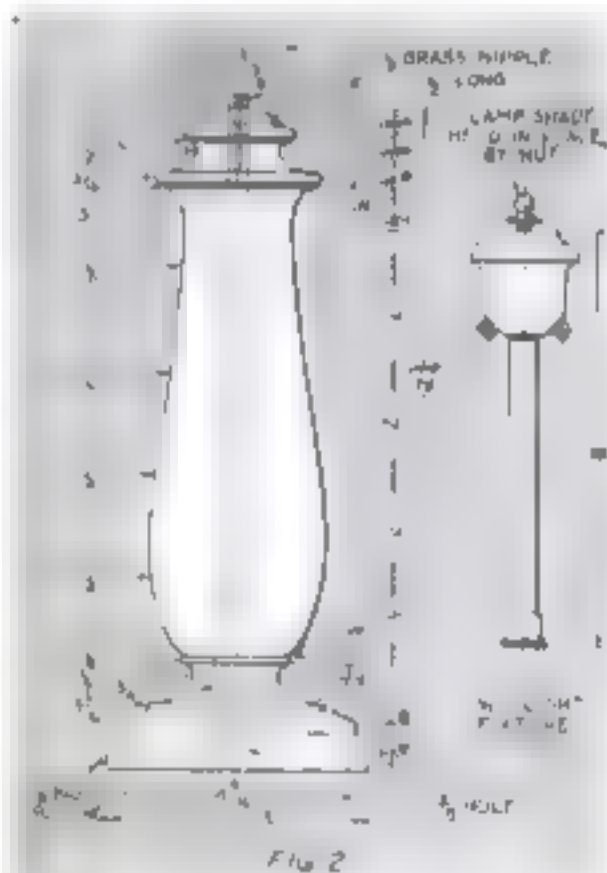
(the tenon) with a piece of soft wood. The hole in the other end is left the way it is and runs on the dead center.

The base may be turned so as to avoid screw holes in its bottom. Get out the stock, plane one side, and screw it to the faceplate as explained in the article on candlesticks published last month.

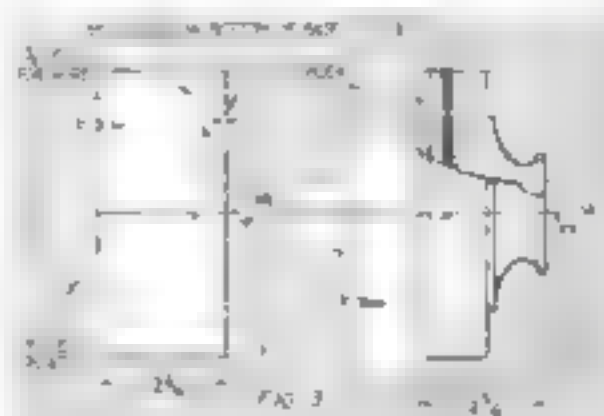
Reduce the wood to the thickness and diameter required and cut a little depression in its center about $\frac{1}{8}$ in. deep and about 1 in. less in diameter than the total diameter of the base (Fig. 3). This is the bottom of the base, and the depression is cut to make it stand well.

Bore a hole with a $\frac{1}{8}$ -in. auger bit into the edge of the base and well past its center. Sandpaper the bottom and edge of the base and remove it.

A device called a "chuck" is now made from a piece of wood, preferably soft and at least 1 in. larger in diameter than the base. This is screwed to the faceplate, faced off, and turned to its largest possible diameter.



Graceful table lamp, the base of which is turned in a wooden chuck as shown below



The base is roughed out on the faceplate (left) then finished in a wooden chuck (right).

Caliper the diameter of the lamp base carefully, mark this diameter on the soft wooden disk, and cut a recess into it about $\frac{1}{8}$ in. deep. The base should fit very tightly in this recess. To begin with, cut well within the line marked and gradually enlarge the recess until the right diameter has been reached.

If the recess should be too large, place a piece of paper over it and drive the base in place. If this does not hold the base tightly, face the disk off and try again. When the base fits properly and is driven tightly up

(Continued on page 187)

Wood Turning

(Continued from page 102)

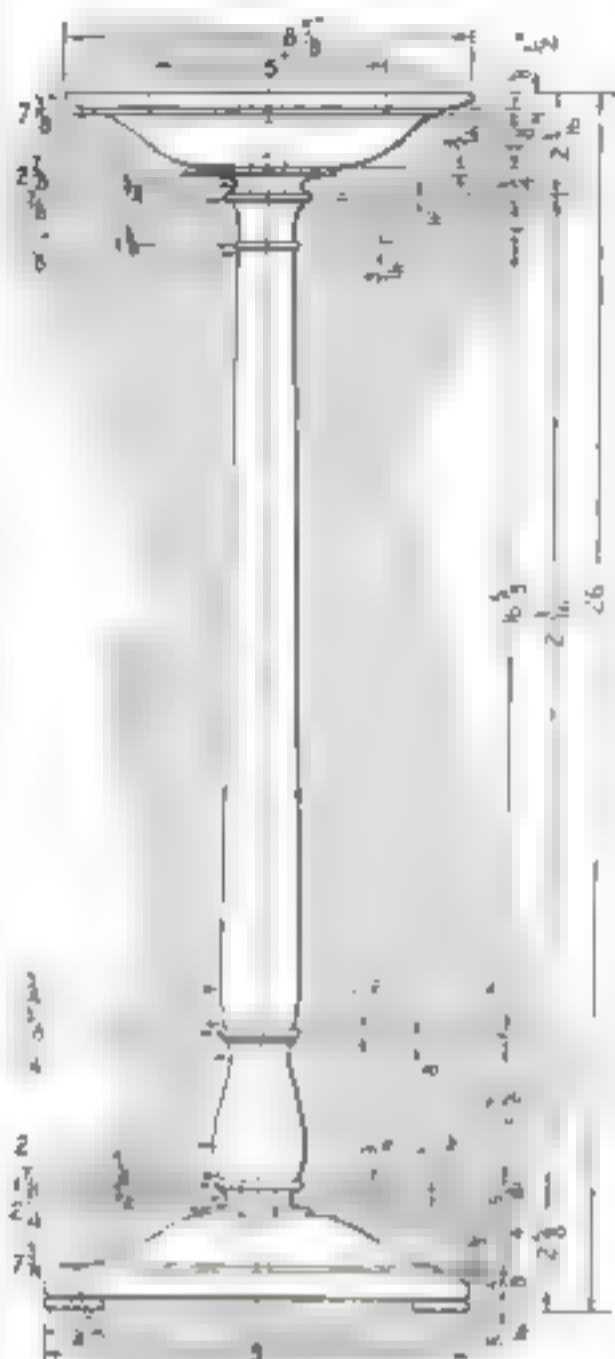


FIG. 4

This stand is an interesting project from the turner's standpoint and makes a fine gift.

against the bottom of the recess so that it runs true—it may be turned in the usual manner without danger of coming loose. This operation is called "chucking." To remove the base from the chuck, grasp it firmly with one hand and tap the face of the chuck with a hammer.

It is best to stain and finish the upright and the base separately.

A 1/2-in. metal bushing is screwed into the hole bored into the side of the base and a 1/2-in. brass nipple about 2 in. long is screwed into the top of the upright so as to project about 3/8 in. Remove the wooden plug from the lower end of the upright, pull the

(Continued on page 104)

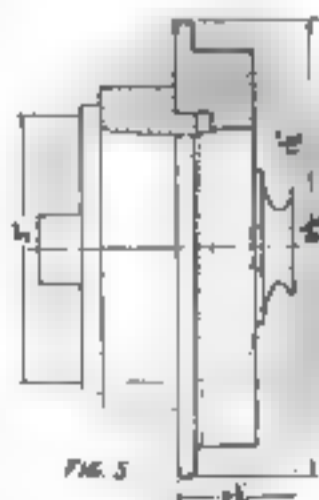


FIG. 5

Now the top member of the smoking stand is held on a wooden chuck.

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TO PROTECT the cord of an electric washing machine against friction and flood and still allow its free movement around the machine, incase it is a section of rubber garden hose as illustrated above.—E. R. SMITH

Wood Turning

(Continued from page 103)

lamp cord through the hole, and glue the upright to the base. The lamp may be held in the lathe until the glue has set, the base fitting in the chuck and the brass nipple over the dead center.

A two-light fixture, such as shown in Fig. 2, is screwed to the nipple. It is fitted with two pull sockets to which the proper wire connections are made. The other end of the lamp cord is fitted with a plug.

The shape, color, and fabric of the shade is a matter of individual taste.

SIMILAR problems in turning are involved in making the smoking stand shown in Fig. 4. It consists of three main parts—the base, the upright, and the top. First turn the upright.

The base may be turned without chucking it, as it is not important to hide the screw holes. When the three little feet are screwed to its underside, it will stand firmly. Before turning these, bore $\frac{3}{16}$ -in. holes for the screws through the center of the stock. The feet are turned exactly as the exercise given under convex turning (June, 1928, issue, page 98).

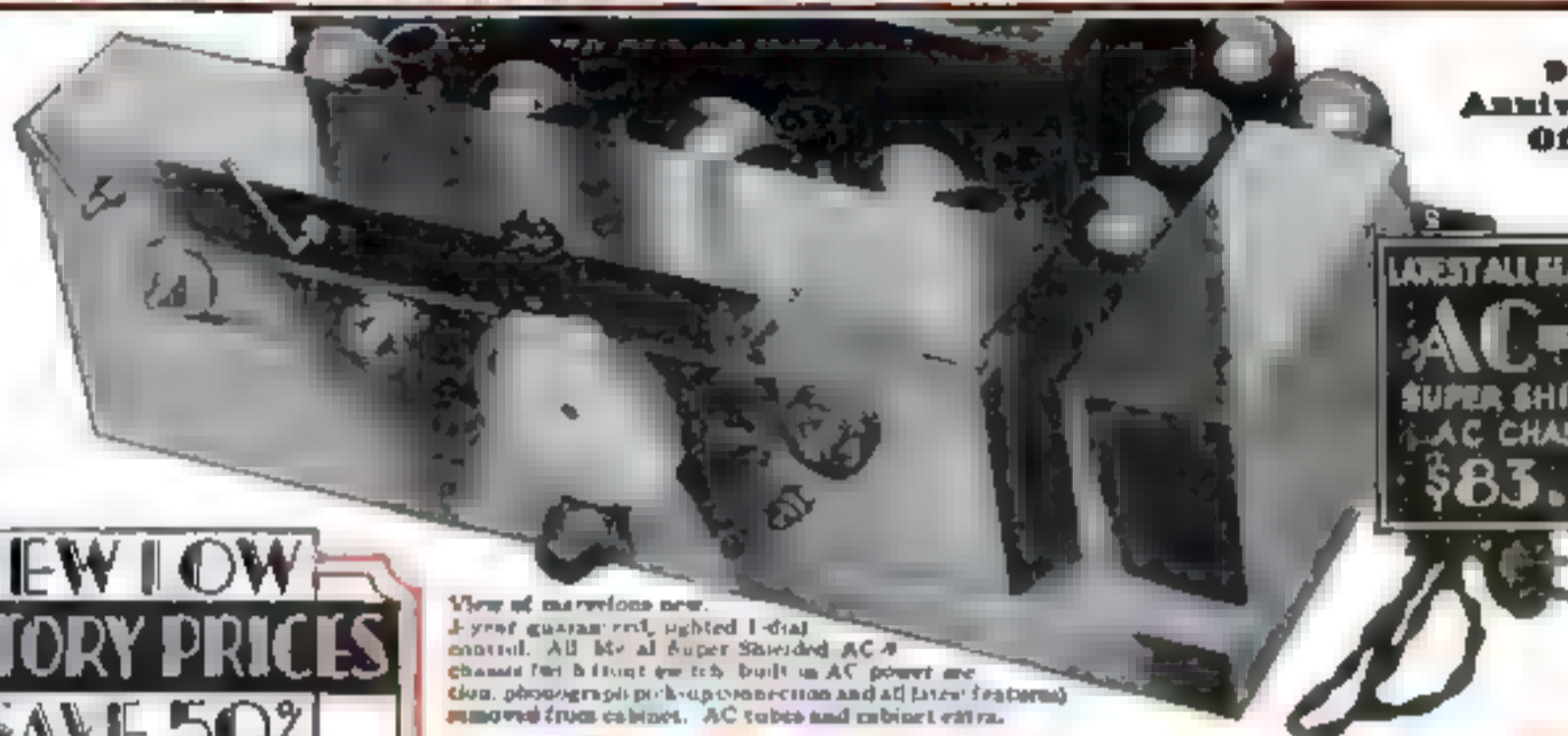
Unlike the base, the top must be chucked when turning to avoid unsightly screw holes. Instead of fitting inside the chuck, as in the case of the base for the table lamp, it fits over it and against a shoulder turned on it (see Fig. 5). The recess cut in the top is for a glass or metal tray. The diameter and depth of this recess, therefore, will vary according to the dimensions of the ash tray.

Glue the parts together and finish the stand as previously suggested.

This is the eighth of a series of articles for home workers who own small lathes and have taken up the recently revived hobby of wood turning.

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hum-free operation, tremendous "kick" on distant stations and razor-edge selectivity—with its costly sturdy construction, latest features, including phonograph

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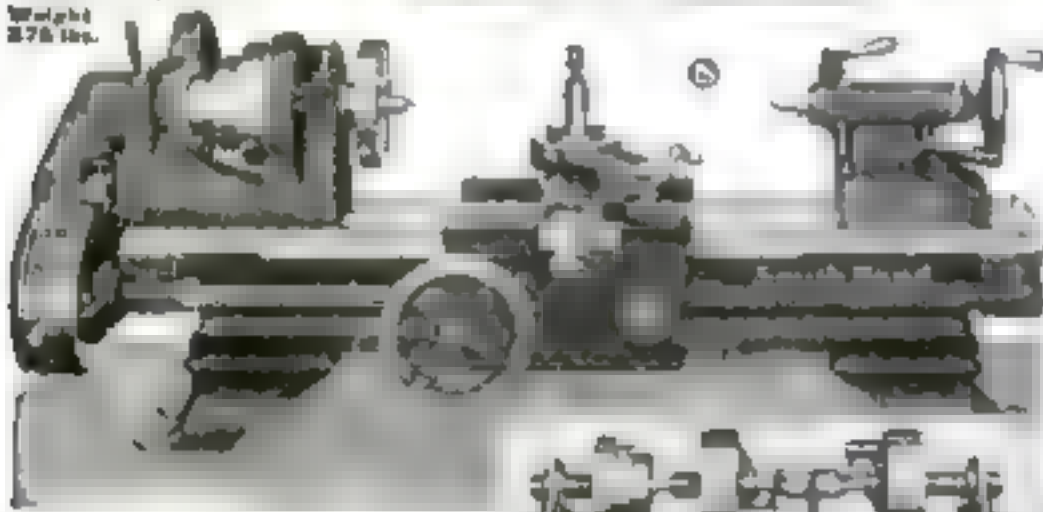
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By WALTER E. BURTON



Painting with a homemade sprayer operated by the air blown from a vacuum cleaner.

WITH a glass jar of the screw-cap type and a few other odds and ends, you can construct a satisfactory paint sprayer to be operated by the handy vacuum cleaner. The use of such a sprayer makes painting a pleasure. It is especially suitable for producing a smooth even finish with quick drying lacquer.

Besides the glass jar you will need a piece of brass pipe or tubing 7 or 8 in. long, the valve from an old inner tube, a few small stove bolts with washers, and a strip of spring brass or other springy metal about 1/4 in. wide and 8 in. long. The brass pipe should be of such a diam-



The sprayer ready for assembly. A glass jar, inner tube valve and brass tube are used.

eter that it will fit the vacuum cleaner hose snugly.

The inner-tube valve stem is treated as follows: The buttonlike part at one end is sawed off, and the remaining threaded tube is ground to a point. The inside valve mechanism is discarded. The tube is fastened to the sprayer at pointed end out by means of two nuts such as are usually found on valves. An extension of tubing is soldered on the lower end if the jar is deep enough to require it. A small hole is drilled in the cap so as to admit air into the paint chamber.

The section of brass pipe which serves as a handle and hose connection is closed at one end by a soldered-on disk in which a 1/4 in. hole has been drilled. A washer of suitable size can be used.

The spray is regulated by the spring brass strip, which is drilled and bent as shown and fastened to the handle by means of two stove bolts. By pressing the strip down until the hole at the forward end comes in contact with the

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Paint Spraying Attachment

(Continued from page 106)

opposite that in the end of the tube, the spray is increased in volume.

Most vacuum cleaner fittings include a blower attachment. The hose from this is connected to the tube of the sprayer, an intervening section of soft rubber tubing can be used if required. When in operation, the cleaner should be supported on a block of wood or in some



The spray is controlled by pressure on a spring brass strip, which regulates the air.

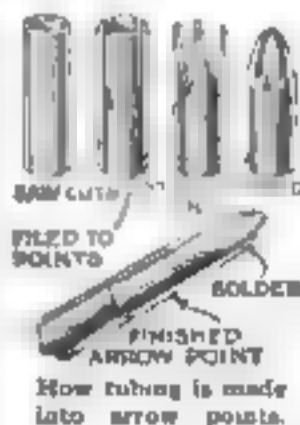
similar manner so that air can be drawn in without difficulty. A fairly thin lacquer, enamel, or paint that is free from lumps will be found best for the sprayer.

If the pressure delivered by the cleaner is not sufficient to produce a satisfactory spray, a small hole should be drilled so as to connect the inside of the sprayer handle with the paint chamber. This will cause a slight pressure in the jar, and the paint will be forced up the paint tube. The hole should not be too large, or the paint will be forced out when the regulating spring is in the "off" position.

Usually the sprayer should be held about a foot from the work, and care should be taken that the paint is not applied in too thick a coating. The best technique can be developed by practice.

How to Make Arrow Points

ARROW points may be made as illustrated from brass or steel tubing, the outside diameter of which equals that of the arrow shaft. Place the tubing vertically in a vise, make two cuts from $\frac{1}{8}$ to $\frac{1}{4}$ in. deep with a hack saw at right angles to each other, and with a triangular file work each cut to a long V-shaped notch. With a light hammer and pliers, bend the points together. Drop a small piece of ribbon or wire solder inside the tube and melt it by applying external heat; also add additional solder to the edges of the cuts. File off the excess solder.—J. V. HAZARD.



Spots and stains often can be removed from a felt hat with very fine sandpaper. In some cases sandpaper does the work as effectively as a commercial cleaning fluid.



Accept 10 Days' Proof

Let us prove that the claims millions of men make for this unique shaving cream are justified

* GENTLEMEN

Pullman car arguments never have yet proved a point.

That's why we make no claims for Palmolive Shaving Cream other than the fact that millions of men, once wedded to rival preparations, have shifted to this new creation.

Hence—that it is worth a trial. So we send 10-day tubes for that purpose. Will you accept one as a courtesy to us?

65 years of soap study stand behind Palmolive Shaving Cream. 129 formulas were developed and discarded before we found the right one. All our experience as the makers of Palmolive Soap.

the world's leading toilet soap, is embodied in this creation.

5 new factors

1. Multiplies itself in lather 250 times
2. Softens the beard in one minute.
3. Maintains its creamy fullness for 10 minutes on the face
4. Strong bubbles hold the hairs erect for cutting
5. Fine after-effects due to palm and olive oil content.

Just send coupon

Your present method may suit you well. But still there may be a better one. This test may mean much to you in comfort. Send the coupon before you forget

PALMOLIVE RADIO HOUR—Broadcast every Wednesday night, from 9:30 to 10:30 p.m. eastern time; 8:30 to 9:30 p.m. central time over station WEAF and 12 stations associated with The National Broadcasting Company.



With the new unbreakable Bakelite top

To add the final touch to shaving luxury, we have created Palmolive After Shaving Talc—especially for men. Doesn't show. Leaves the skin smooth and fresh, and gives that well-groomed look. Try the sample we are sending free with the tube of Shaving Cream. There are new delights here for every man. Please let us prove them to you.

10 SHAVES FREE

and a can of Palmolive After Shaving Talc

Simply insert your name and address and mail to Dept. B-1556, Palmolive, 3702 Iron St., Chicago, Ill.

Residents of Wisconsin should address Palmolive, Milwaukee, Wis.

Please print your name and address

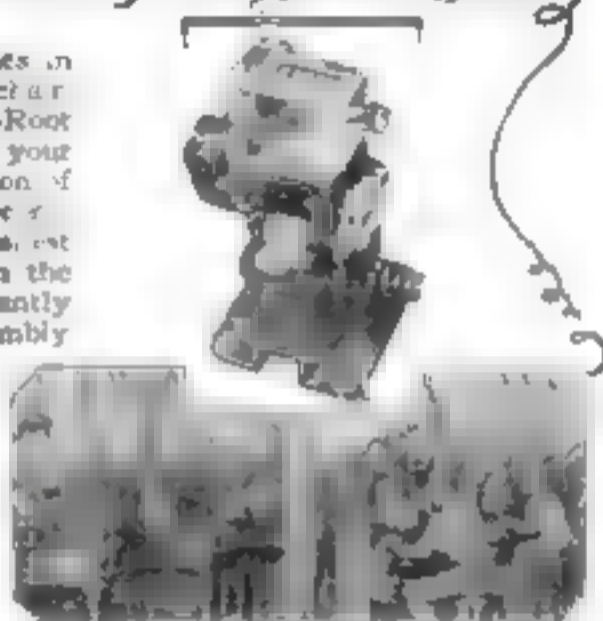


Veeder-ROOT Remote Indicating Magnetic Counters Offer

PRODUCTION CONTROL from your Office

You can watch and control machines in the shop without leaving your office. A glance up at the dials of Veeder-Root Counters, banked on a board over your desk. There, you read the production of any machine any minute. The record in total, of finished products or smallest parts. No waiting for reports from the factory. They're wired to you instantly—electrically—from machines or assembly lines.

Mechanical contacts on machines in the shop make and break the electrical circuits which operate the counters over your desk. Your regular lighting circuit supplies the current. Also counters to operate on storage battery. Ask for our brown book of Counters for all machines and development work.



Veeder-ROOT INCORPORATED

HARTFORD, CONN.

A definite program for getting ahead financially will be found on page four of this issue.

Cut Your Costs on Millwork by Making Your Own with the H & A MILL SHAP

Makes your own mouldings, heading matching etc. at a fraction of the usual cost. A sturdy high grade precision tool; portable; electric. Take it right to the job. Write for catalog and prices.



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OTTAWA LOG SAW

only 39

GREATEST OFFER
EVER MADE

Make Money!

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INDIVIDUAL MACHINES MAKE THE BEST WORKSHOP

You can do heavier work and a larger variety of jobs with individual machines in your workshop. Holeson-Crane machines are each designed for one maximum efficiency and are superior in size, capacity and ability.

You can stock your shop with any one of the units in the Holeson-Crane Workshop illustrated, and enlarge it as desired.

Sand Saw, 12-inch V.E.W. like new universal 16-inch machine. A high-grade Holeson-Crane product. \$35.00

Send 10c for the Holeson-Crane Catalog illustrating and describing these extraordinary machines.

Hardware and Machinery Dealers Wanted
Write for attractive proposition

W. S. & J. E. HOLESON

Dept. P. E. 11-8 Toledo, Ohio

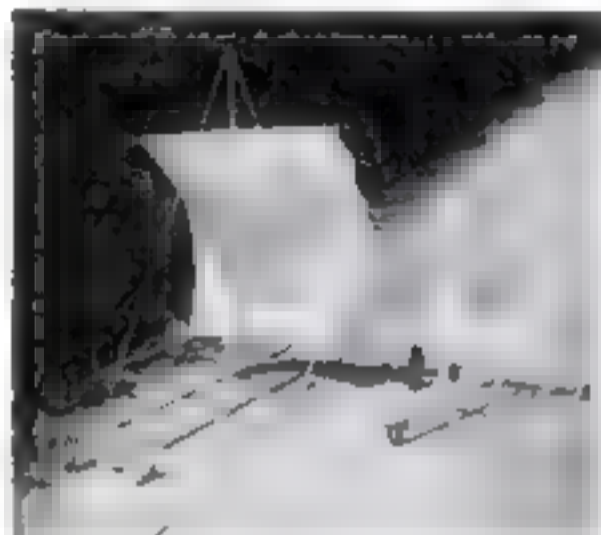
Lathe, 16-inch as shown. \$29.15
Universal Hand Saw, 4 blades with
adjustable head. Will do more heavy and
difficult jobs than any other you can
buy. Why not make it the pride of
your shop? With a high saw. \$12.75
Hand/Joiner, 16-inch V.E.W. 12-hp.
greater power and capacity than
any other similar to you \$24.00 previous
models. Has features never before
offered in a machine of such low cost. \$28.00
Universal Fly Saw, 16-inch
low blade or heavy power design, up to
1 1/2 inch wide. Cut straight or
the high curve. \$12.00
Complete Shop as illustrated with two
1 1/2 h. p. motors \$192.00



Model Land Yacht Racing Is Boys' Latest Sport

By Charles M. Miller

Assistant Superintendent of Manual
Training, Los Angeles City Schools

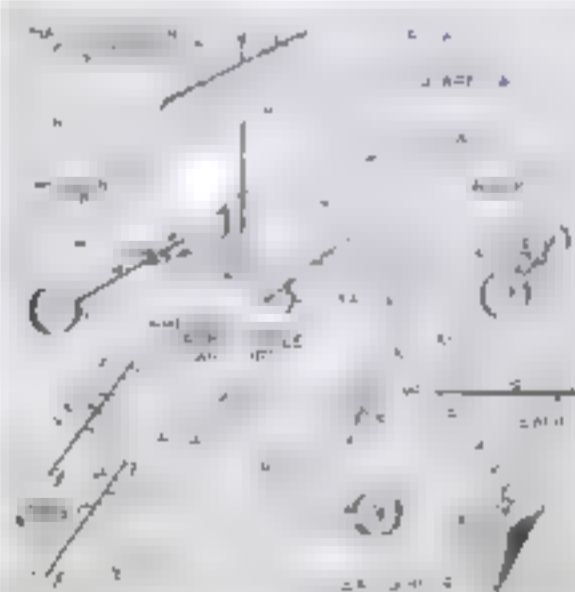


Two small, speedy sail wagons. They resemble toy yachts, but travel on wheels.

WATER yachts are tame beside these little runways that rush along the pavements almost as fast as the wind. All kinds of sails may be used, and won't with running before the wind or tacking, there are problems to keep the owner on his toes through all the windy playdays of fall.

Land sail wagons are sometimes large enough to carry the pilot, indeed, boys often attach a sail to an express wagon. Such crafts, however, are a nuisance on sidewalks and of some danger to old people and children. Small models give just as much fun and are proving an attraction wherever they are exhibited before groups of boys.

In the simplest form, the framework consists of a front axle and a spine, reach, or beam running from the axle to the rear end. Three wheels are used on this framework. A short axle may be used at the rear, in which case four wheels are required. The three-wheel type shown is more suitable for a square sail when running with the wind, the four-wheel type *(continued on page 169)*



A 4 ft. long model rigged with a square sail; and both three and four-wheel frameworks.

Model Land Yacht

(Continued from page 108)

with an adjustable rear axle is better for tacking.

The axles and reach may be from $\frac{3}{4}$ to $\frac{1}{2}$ in. thick and from 1 to $1\frac{1}{4}$ in. wide. For a 4-ft. model the width between the front wheels should be about 2 ft. 6 in.

The wheels can be attached by means of wheel blocks, on the axle ends, except in the case of a single rear wheel, when extension strips are used, as shown.

The tops from coffee or other tins can be made into excellent wheels. If tin screws are used the wheels are likely to wobble to overcome this nail a small hub to the inside of each tin disk. The hole through the wood should be a trifle



A four wheel model with sail furled to show construction at bowsprit and trans axle.

large, the real bearing being at the center of the tin disk.

A good location for the mast is about one third the distance from front to rear. A $\frac{1}{2}$ - or $\frac{3}{4}$ -in. hardwood dowel 3 ft. high will serve as the mast, and a piece of $\frac{3}{4}$ -in. dowel for the flagpole.

A square sail requires a yardarm near the top. The lower corners are held by two pieces of cord lashed to a crosspiece, which is placed about one third the distance from mast to stern. Stays from the mast top to the fore and stern ends of the spine serve to brace the mast and stays from the ends of the yardarms prevent the sail from twisting.

A little ballast may be necessary in a strong wind—a lead sinker with a wire hook hung at any point on the crossbar.

While square sails are placed on the majority of these craft, many of which are built and used in the Los Angeles school playgrounds, it makes the sport more interesting, as soon as some experience has been gained, to rig regular yacht sails.

A Primer for Yellow Pine

YELLOW pine woodwork is sometimes primed by painters with a mixture of white lead and red lead in equal quantities, thinned with raw linseed oil, turpentine, and benzole in equal parts. The advantage of this priming is that it effectively seals in whatever pitch there is in the wood and forms a durable base for the finishing coats, whether oil paint, flat paint, or enamel undercoater

for Men Who Take Pride in Their Tool Kits



Carborundum Combination Stones

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IN attic and cellar workrooms, where zealous home-craftsmen patiently labor, there you will usually find Carborundum Sharpening Stones keeping all edge tools efficiently keen-cutting.

Experienced craftsmen know the value of keen, edged tools. That is why Carborundum Combination Stones are in thousands of their tool kits. The coarse-grit side removes nicks and brings the tools to an edge. The fine-grit side gives the keen, smooth, finished edge.

Made of Carborundum—harder, sharper, faster-cutting than any other material.

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"HOW TO SHARPEN EDGE TOOLS"

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and in The Carborundum Company's
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SAWS FILES KNIVES STEEL

CROSS-CUT SAWS THAT LESSEN LABOR

NO cross-cut saw so far developed, cuts faster or holds its sharpness longer than a Simonds Cross-Cut Saw. The reason is that Simonds Cross-Cut Saws have the excellence on the foundation of the highest grade of specially treated steel. It is welded by the finest craftsmen. The result is a saw that does a better job than any other saw. It is the only saw that can be used for all kinds of work.

SIMONDS SAW AND STEEL CO.
Fitchburg, Mass.

"The Saw Maker"

Established 1862

Branch Offices and Service Shops in Principal Cities

The Best \$10.00 You Ever Spent

Only \$10.00 Down

You can get the best of both worlds. Liberal discounts for cash.

Send us 10-day FREE TRIAL

Use our shop for 10 days at no expense. If not satisfied, return at once without cost.

FREE BLUE PRINTS

We'll design blue prints for hundreds of things you need and other most handy tools. These are free with purchase.

SPECIAL CRAFTS COURSE ALSO FREE

Under personal supervision of Master Craftsmen, you can learn to make things that are not only useful but also beautiful. This course is free with purchase.

Our Literature Gives All Details. Send to **UP-TO-DATE MACH.** W.K.S. 2415 So. Wabash Chicago, Ill. (USE CORNER COUPON)

NEW 12' Band Saw

Newly developed, of the latest design in Band Saw machine, the 12-inch Band Saw is guaranteed to be the most efficient and accurate of any size. It is supplied with a 12-inch table and a 12-inch band.

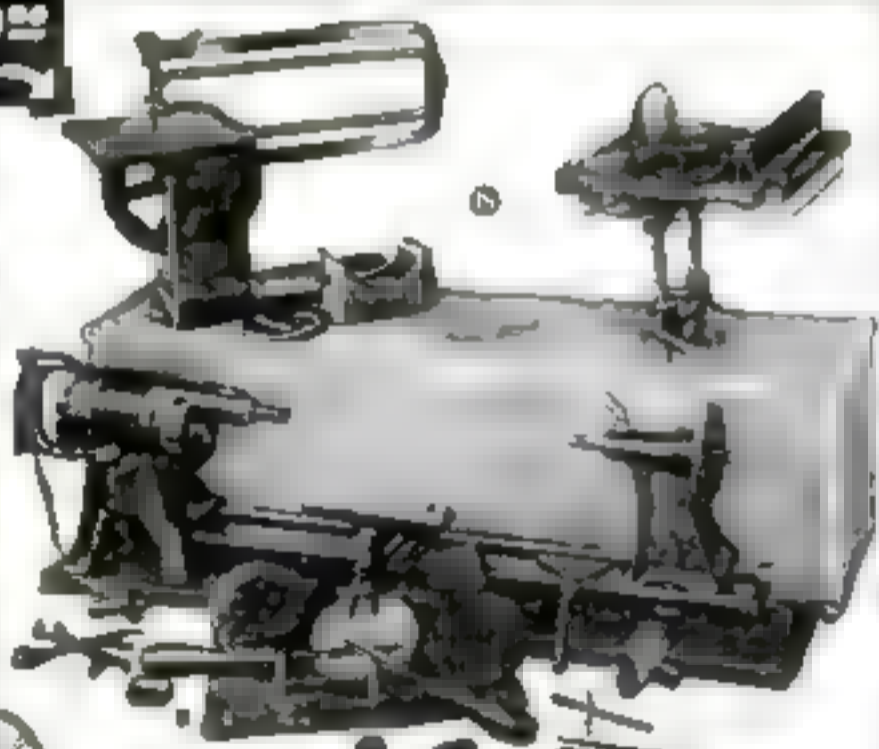
\$35

F.O.B. CHICAGO

May be purchased on 100% payment basis at \$30.00, \$10.00 down and \$20.00 per month. With this plan anyone can own a new Band Saw.

GUARANTEE

If upon receipt of the machine you are not satisfied, we will refund every cent refunded and return express charges paid.



THE UP-TO-DATE HOME CRAFTSMAN SHOP

Plug in on any light socket and go to work. Make your old work bench a modern Up-to-Date workshop. THE SHOP COMPLETE consists of a Super-power Motor an accurate Lathe (10" x 34"), a 12" circular saw which features the bevel, miter and depth, a Table, Jig Saw, and all accessories for cleaning and all other work.

MAIL THIS FOR FULL PARTICULARS TO

Up-to-Date Machine Works Dept. 23
2415 S. Wabash Ave. Chicago, Ill.

Manager Dept. 23 Without any obligation please send me all particulars about the Up-to-Date Machine Shop. I will send \$10.00 down and \$20.00 per month.

Name _____

Address _____

The Handy Man

(Continued from page 88)

Oh, I would find my Handy Man! I would find a dry-goods clerk sneaking up to the attic out of Second-Grade Mary's way, praying she won't discover him, because he loves her so much. And why? Doll's house! Two stories, with bathroom and cupola. Glazed windows cut with father's glass-cutter! Pilasters smoothed with father's little block plane! Green and white color-varnish flowed on from father's little brush! Real shingles on the little roof out of that extra piece of printed linoleum father saved. Got to get busy if it is to be ready for the Birthday.

Doll's house! You can buy them in the stores. But if you do, you commit sacrilege. A doll's house is holy when father makes it. He's twice the father, and Second-Grade Mary will never forget that little house if she lives to be ninety. What she always remembers is, "Father made it for me with his own hands." Handy Man!

Oh, keep on, brothers, even if you never get your diploma. Keep on making things and mending things with your own hands. Never mind if so-called "practical men" say you fiddle away your spare time and money. What do they do with their spare time and money?

And you women. Be human. Let your husband make a few shavings in the kitchen. Let him clamp his little vise on the table. Let the boy heat his soldering iron on the gas stove. If you don't, you're killing something divine which the Creator put into that man, and it must come out. Men can't bring forth babies. They can't be forever at their regular work. Let them be Handy Men—and fervently thank God if you've got one in your home.

Postscript.—Some happy day the good architects will do a new thing. Instead of marking that little 8 by 8 room, "Den" (you'd think a man was a bear), they'll mark it "Home Workshop"! Why not?

Fastening Oversize Storm Sash

WHEN appearance is of no great importance, a ready-made storm sash often can be used without any fitting, for a window not of a standard size. It is merely fastened on the outside of the casing as shown, by three or four screw eyes on each side and one in the center at top and bottom. In this way it is possible to use a sash that is 2 or 3 in. wider than the inside width of the window casing.—H. L. W.



Storm window held with screw eyes.

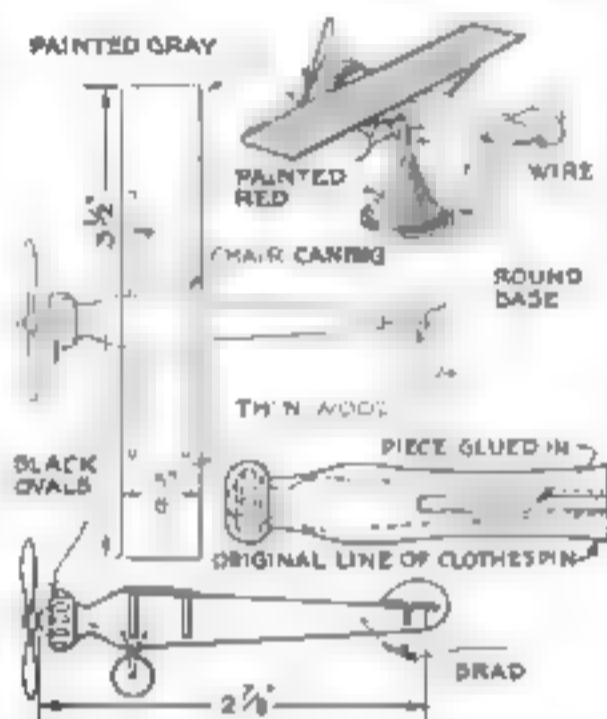
The clogging of the throat of a plane usually is caused by the cap iron's being too thick or not fitting the face side of the cutter perfectly. Judicious filing of the upper and under sides of the cap iron with a flat file will remedy either trouble.

Model Airplane Has Clothespin Body

By F. Clarke Hughes

SMALL model airplanes are attractive novelties for use as ornaments, favors, or toys.

The body can be whittled from a spare piece of soft pine, or a clothespin may be used. A good length is $2\frac{3}{4}$ or 3 in. and the breadth and depth in proportion. The wings are best made from very thin,



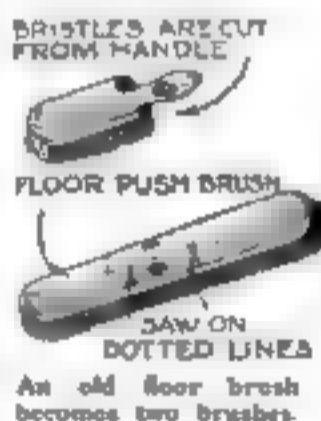
Top and side views and sketch of the plane show the body is made from a clothespin.

soft pine. They are merely glued in place. The stays may be made from pine, reed (cane), or bamboo, such as that used in making flying models. The motor and propeller are carved with a pocketknife.

After the model has been lacquered a light gray, it may be placed on a small red base, such as the one illustrated, or suspended by means of a black silk thread from a chandelier or other support.

Cheaply Made Dust Brushes

TWO good dust brushes often can be made from a discarded floor push brush, provided the brush is not too badly worn. Saw it according to the accompanying diagram, trim away the hair on what are to be the handles, and dress the handles with a rasp or coarse file. While the handles are not centered, this does not matter.—FRED W. HARTON.



Substitute for Rubber-Stamp Pad

A SUBSTITUTE for a rubber-stamp pad can be made by wrapping a length of typewriter ribbon around a piece of cardboard and fitting it into an old stamp pad box. When the pad no longer gives a clear impression, the outer layer of ribbon can be cut away

Just notice the fine skins of men who use WILLIAMS!



The Cream that leaves FACES FIT!

The absolute purity that comes from triple distilled ingredients

Eighty-eight years of specialized study in blending these ingredients

These, among many other things, have put Williams Shaving Cream in a class by itself.

Have you tried it? Yes, of course? Then we don't need to tell you anything more about it.

And listen to the drug clerk. He has a chance to know. "Oh, yes, sometimes they change, but they all come back to Williams!"

The J. B. Williams Company, Glastonbury, Conn. - Montreal, Canada.

Next time say

"Williams Shaving Cream please!"

Afterwards find out how perfectly AQUA VELVA completes the shave.
Made just for that!



Where's the can of PLASTIC WOOD?

(Reg. U. S. Pat. Off.)

A sail boat broken, a damaged toy—it's a real tragedy in child life. But Plastic Wood, which Handles like Putty, Hardens into Wood, and holds fast to wood, metal, fabric, plaster, porcelain or glass will quickly effect cures that would make a surgeon or magician green with envy. Keep it on hand for toy accidents—and use it for repairs of all kinds around the house; floor, baseboard and door cracks; loose casters, handles, and furniture; mouse holes, screw holes, nail holes; cracked tiles and porcelain bathroom fixtures.

PLASTIC WOOD

(Reg. U. S. Pat. Off.)

White Waterproof Tile Cement.

For the bathroom, when the porcelain splits, cracks open up around the tiles, or a wall fixture comes loose, Plastic Wood White Waterproof Tile Cement is of immense value. It will hold broken pieces, seal cracks, is impervious to water, and dries to a hard flat white. At the same prices as Plastic Wood.

Plastic Wood Solvent.

Plastic Wood dries rapidly, and often when working it becomes necessary to soften or thin it. A few drops of Plastic Wood Solvent will renew the wood that has started to dry. Plastic Wood Solvent, in 25 and 50-cent cans, can be bought through your dealer.

Handles
like
Putty



Hardens
into
Wood

1 lb. can \$1.00

$\frac{3}{4}$ lb. can 35 cts.

At Hardware and Paint Stores

ADDISON-LESLIE COMPANY

309 Bolivar Street

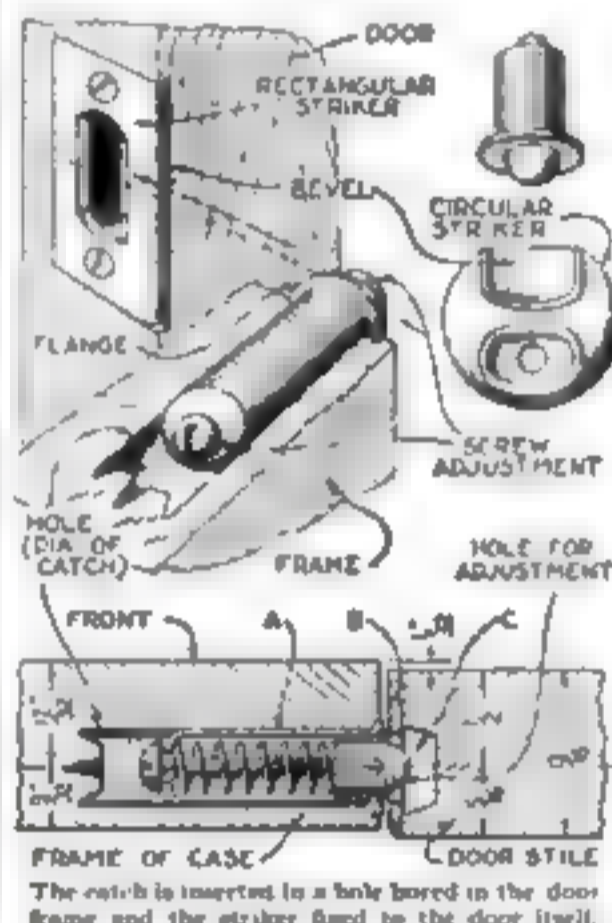
Canton, Mass.

Door Catches That Anyone Can Apply

THE home worker often desires to keep the door of a cabinet or cupboard closed without the use of a lock, a latch, or a surface catch of any kind. The best solution is to apply a friction catch, which is cheap, efficient, and, above all, easy to fit.

Ball friction catches usually range between $\frac{1}{4}$ and $\frac{1}{2}$ in. in diameter and $\frac{1}{2}$ and 1 in. in length. The size most commonly used for work about the house is $\frac{1}{4}$ by $\frac{1}{2}$ in., for a catch of that size may be safely placed in a $\frac{3}{8}$ -in. rail or partition.

This type of catch may be purchased in almost any well-stocked hardware store. It is best to obtain the adjustable variety, if possible; then the ball may be screwed in or out to compensate for the shrinkage or swelling of the door. To turn the ball, it is necessary to insert the points of a



pair of dividers in the slots or holes made for that purpose.

Fit and hang the door accurately allowing for the "sinking"—let us say $\frac{1}{8}$ in. Then it is necessary to decide whether the catch is to be located in the top or bottom edge of the door about 1 in. from the lock edge, or in the lock edge of the door near the knob or pull.

If the face of the door twists out a little or is not perfectly straight at the top, the catch may be placed at the top; it will then hold the door straight unless it is too badly out of true. If the lower corner springs out when the door is closed, the catch should be placed there. If placed near the center of the lock edge, the shrinkage of the door may demand more frequent adjustment of the catch, but the door can be opened and closed more easily.

Locate the center of the catch about as indicated, the dimensions being intended to show only the relation between the ball and the front of the frame as compared with the center (Continued on page 113)

"Lava-clean" hands are clean!



Men—you who love to tinker—here's just the soap you need. Cleans quickly and thoroughly the toughest working pair of hands that ever fused around a work bench. Makes more lather in 15 seconds than ordinary soap in 60, and even hard or cold water won't discourage it. Millions use it. "Good old Lava" they call it. Get hands clean. Not just "surface clean," but clean way down deep. As easy on your hands as fur lined gloves—because it's made from the finest of vegetable oils. All stores sell it.

Full size cake of Lava Soap FREE!

-----Mail this coupon-----

Prayer & Gumble Dept. X 1128
Cincinnati, Ohio.

Please send me, FREE, a full size cake of LAVA, the hand soap that removes all the dirt and grease.

Name _____

Street _____

City _____

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MODEL AIRPLANES Ready to Fly

Designed like and look like the real airplanes—be built of St. Louis, The Freeman, The Hurricane and the Barker. EVERY MODEL AIRPLANE IS A PERFECT FLIER. We fly from 100 to 500 feet and at one drop from a ten plane at 1,000 feet. They make perfect postage with a scratch. A motor unit is built, sturdy, with a propeller designed along with the whole and built together as one piece. Get one now and with a few more pieces like other boys are doing. Packed in strong corrugated boxes, they come to you ready to fly. I read at the factory and guaranteed to fly and land like the real planes. So our model airplanes are above wing spread 70", with a 10" propeller of 30". Order now and let the fun begin!

Catalog and Free Glider 10c

AMERICAN MODEL
AIRCRAFT CO.
Dept. 3
New Haven, Conn.



Simplified Eye Splice for Ship Models

THERE are many places in a ship model—as in attaching dead-eyes to the shrouds, fixing pendants to rigging blocks, and making eyes in the stays—where an eye splice would be useful, but owing to the small size of the majority of "ropes," a true eye splice would be impossible to make.

To make a simplified splice, the first thing is, of course, to fix its location. With a pointed "marlinespike" of wood or metal, open up one strand of the standing part after passing the running part around the dead-eye or block. Pass the end under the open strand and pull it snug. Finish the splice with one or two more tucks, going over one strand of the standing part and under the next one, as in a regular splice.

Apply a little diluted glue, cut off the sea end when the glue is dry, and you will have a nice splice.

I have found that excellent results can be obtained by using shoemaker's black wax to "tar" all rigging before setting it up. The wax helps to stick lashings, knots, and splices in position and is a protection against moisture. Draw the lines over the wax.—W. E. PATRICK, Jr.

Catches Anyone Can Apply

(Continued from page 112)

of the striker socket and the face of the door. The dimensions will vary with the thickness of the door and frame and the surface sinkage of the door.

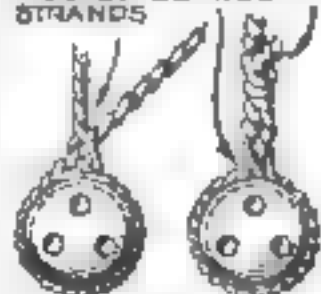
Bore the hole in the frame to receive the plug and drive the plug into the bore as at A. Close the door and work it back and forth a few times to mark upon the edge of the door the point where the center of the ball rests when the door is closed. A broad chalk mark made at this place to receive the track made by the ball will make the point show more definitely.

Place the striker plate on the door with its beveled edge facing the inside of the door as at B. Have the center of the striker socket coincide with the center point marked by the ball on the edge of the door.

Mark accurately around the striker with a sharp-pointed knife. With knife or chisel cut a recess to these lines so the face of the plate will fit closely, and of the depth to allow the striker plate to rest flush with the wood when fastened in place with screws. Cut away the wood under the striker socket to allow the ball to enter freely as at C.

If the frame of the door opening is not thick enough to receive the plug, it will be necessary to set it in the edge of the door. This is not so satisfactory as placing it in the frame.—CHARLES A. KING.

WHOLE END OF CORD
TUCKED BETWEEN
STRANDS



SIGHT OF ROPE AS
IN DOUBLE STAYS

How realistic little
splices may be made.

NOW! The Encyclopaedia that Never Grows Old

When daring airmen bridge the continents in a few hours, a great flood sweeps the Mississippi Valley, a new treaty for world peace is made—when Medicine triumphs over previously incurable disease; or electrical energy performs new wonders—as oil heating for homes is perfected—*always* the FIRST permanent work of reference to fully record it is NELSON'S Perpetual Loose-Leaf Encyclopaedia.

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Every one has felt that he would like to own an

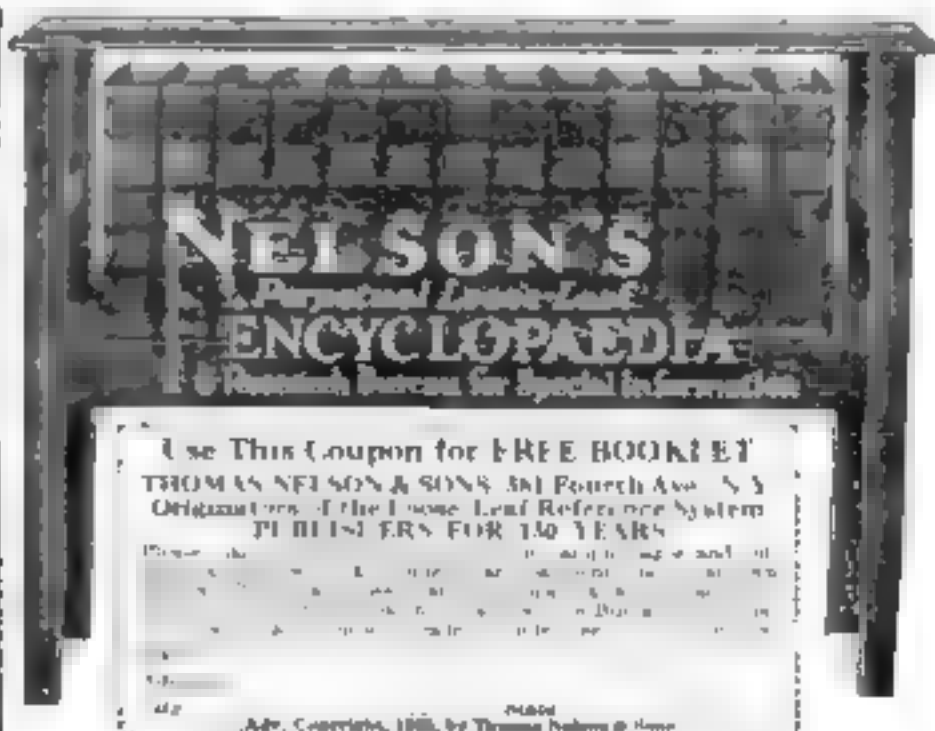
authoritative encyclopaedia—many have hesitated to make the investment knowing that encyclopaedias get "old" so quickly. But now you can buy a Nelson Encyclopaedia knowing that it will last you a lifetime and *always* be up to the minute. And you can buy a Nelson Encyclopaedia for surprisingly little money.

You will find below a coupon that will bring you a book of beautifully illustrated sample pages including many pages showing illustrations and maps in full colors. Also this coupon will bring you full details about free membership in Nelson's Research Library Service Bureau and the Free Reader's Guide Service.

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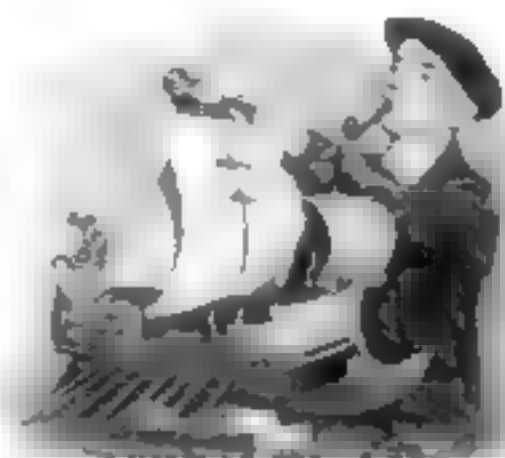
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Ship Model Contest Aids Tuberculosis Work



Edward Thatcher with a Roman galley he built for the Tuberculosis Association.

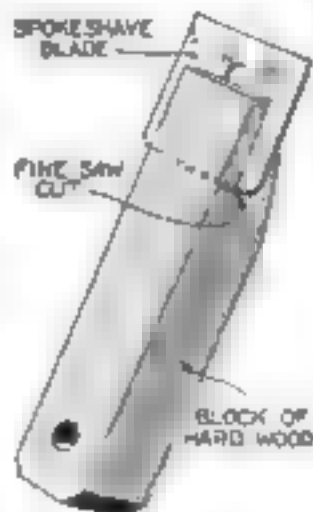
SHIP model builders now have an opportunity to compete for prizes in a series of local or state contests being conducted to aid the work of the National Tuberculosis Association. The model must be a Phoenician, Greek, or Roman ship resembling the argosy that is pictured on the Association's 1928 Christmas seals.

Edward Thatcher, who is a regular contributor to the Home Workshop Department of POPULAR SCIENCE MONTHLY and a distinguished American craftsman constructed for the Tuberculosis Association a Roman galley of the general type desired in all the competitions. He also prepared an illustrated booklet telling how to build one like it.

Hearers who have successfully constructed POPULAR SCIENCE MONTHLY ship models and have thereby gained valuable experience in this fascinating work will be well equipped to enter the contests. They can obtain a copy of Mr. Thatcher's booklet and the contest rules from their state or local Tuberculosis Association.

Holder for Sharpening Spokeshave Blade

SHARPENING
A spokeshave blade is a problem that often gives the home worker some difficulty. That is mainly because a blade is so hard to hold. A good holder, however, can be easily made from a block of wood as shown. The blade must fit tightly in the slot, which should be cut with a fine saw. I have used one block of this type for more than fifty years. J. J. FREEMAN.



Block for giving a grip on the blade.

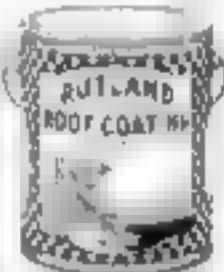
FINGER spots and other marks on painted woodwork and walls often can be removed by rubbing them with a rag moistened with vinegar and dipped in baking soda.

Stop that leak in your roof

BEFORE it causes costly damage stop it with Rutland No-Tar-In Roof Coating. No trouble at all to apply, costs little and makes leaky roofs as good as new.

Rutland No-Tar-In provides a perfect coat of asphalt and asbestos—a tough mineral covering. Not a drop of tar in it. It will not crawl, sag, harden, peel or blister. For every kind of roof (except shingles).

Invest on Rutland your hardware or paint store. If your dealer hasn't it, mail order below. Rutland Clay Co., Dept. 1, Rutland, Vermont, makers of Rutland Finishing Paper.



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Cabinet
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Special
No. 10
\$290
with Motor



You ought to have this handy Parks in your shop. Compact, complete machine designed like a big production outfit at 1/3 the cost. Fits in a corner of your basement. Does any kind of cabinet or joinery work. Write for circular.

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Home Workshop Chemistry

Simple Formulas that
Will Save Time
and Money

WHEN wood with knots in it is used for building purposes, as frequently must be done, the knots often fall out. Such holes are best repaired by means of a plug of softer wood cut to a size slightly larger than the hole and having a minute taper. Roughen the inner surface of the hole with a rasp and force the plug in position. If necessary, hardwood wedges may be forced into the soft wood plug to make it still firmer.

Casein glue (purchased at a paint or hardware store in the form of a white powder and often called "milk" or "air-plane" glue) may be used to fasten the plug in position. Then, too, the knot itself may be glued in place with casein, but it seldom fits tightly enough.

Small holes may be filled entirely with a casein cement, made from the prepared



Casein for use in making waterproof cement can be precipitated by adding acid to milk

commercial casein glue or prepared at home by precipitating casein from skim milk by the addition of a little vinegar or acetic acid—merely sufficient to coagulate the casein. This is then washed with water and dried in the air. The particles are broken up and slightly heated to drive off all moisture. Then the casein is powdered and mixed with burnt and powdered lime (calcium oxide).

For every part of casein by weight, take one part of powdered lime. Keep the powdered mixture in a bottle and moisten it with water just before using.

A number of water-resisting cements are known, and some of the better types may be briefly described as follows: Mix about equal parts of fresh casein, plaster of Paris, and red lead, or mix rye flour with freshly slaked lime, or cement with waterglass; or use carpenter's glue dissolved in water to which Portland cement is added until the consistency is satisfactory for use. This material hardens in a few days. If desired, one or two parts of sand may be added to give more body. Use this cement as soon as made.

Another useful cement consists of three parts of rosin mixed with one of beeswax. The rosin is melted and the wax added. This cement must be used hot, but it can be remelted at any time. It is a good cement for knife handles and is waterproof.—E. BADE.

Beard Tough... Skin Tender? Forget it Men!

Whiskers come off quick and smooth when beards are softened small-bubble way. No razor-pull, sting, or smart. Read how this new-type lather takes razor-pull out of shaving. See our no-cost offer in coupon below.

DOES the above headline surprise you? Are you one of those men who believe that shaving, at best, must always be uncomfortable . . . that razor-pull, sting and smart can never be completely done away with? If so, you'll find lots of good news in this advertisement. It's the story of a new, quick way to get your whiskers off. A way that's faster . . . cleaner . . . smoother than any you've ever known before.

You'll discover the difference the minute you try it. You'll see it in your mirror. Instantly your face feels serene and comfortable . . . delightfully fresh and clean.

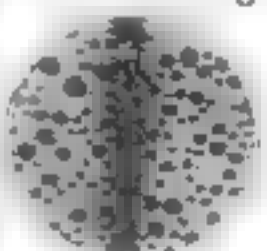
How it works

No other shaving cream is like Colgate's. No other can offer you such unique results.

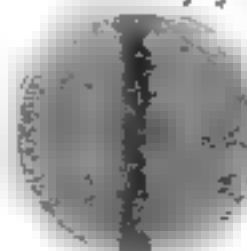
It is, we believe, the ultimate attainment in the science of beard softening.

Colgate lather is designed to absorb more water . . . to scientifically drench your beard with moisture at the base, where the razor work is done.

It's a "small-bubble" lather. For small bubbles hold more water. They carry it closer to the base of your beard.



Ordinary Lather
Photomicrograph of lather + of an ordinary shaving cream containing single hair. Large dark spots are air—white areas are water. Note how the large bubbles hold air instead of water against the beard.



Colgate Lather
Photomicrograph prepared under identical conditions shows fine, closely knit texture of Colgate's Rapid Shave Cream lather. Note how the small bubbles hold water instead of air close against the beard.

That's the principle, men. Now here's what it does for you:

1. The soap in the lather breaks up the oil film that surrounds each tiny hair . . . floats it quickly away.

2. Then billions of tiny, moisture-laden bubbles seep down through your beard . . . crowd close around each whisker . . . soaking it soft with water.

Instantly your beard gets moist and pliable . . . limp and lifeless . . . scientifically softened right down to the base . . . ready for the razor.

Thus your whiskers come off clean and smooth. We will gladly send a seven-day trial tube. Also a sample of "After Shave," our new-type lotion.



"Yes! Real! Small bubbles sure get whiskers off quick. That's what most of my gentlemen ask for."

COLGATE
RAPID-SHAVE CREAM



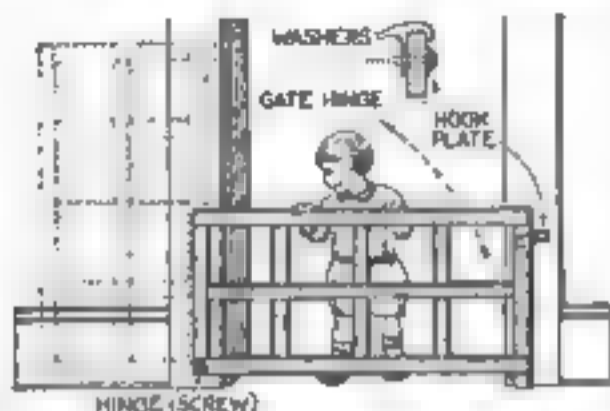
Colgate & Co., Dept. 500-E FREE OFFER MEN
100 N. 4th St., New York

Please send me 1 tube of Colgate's Rapid Shave Cream. Also sample of Colgate's After Shave.

Name

Address

One Screw Acts as Hinge for Hanging Baby's Gate



Little damage is done to the woodwork when a gate is hung by this simple method.

HOW to fasten a baby's gate temporarily to a door or a porch railing without unnecessarily damaging the woodwork or going to too much trouble, is a problem that is frequently encountered. One simple solution is that shown above. The gate is pivoted on a long wood screw in such a way that it can be instantly tipped up out of the way. The catch can be made of metal or cut from a block of hardwood.—FRANK M. DUGAN.

How to Build Corner Cabinet

(Continued from page 114)

stops and back post should be bored with holes about 1 in. apart to suit small shelf pins. Leave at least 3 in. unhored at top and bottom. Bore all exactly alike.

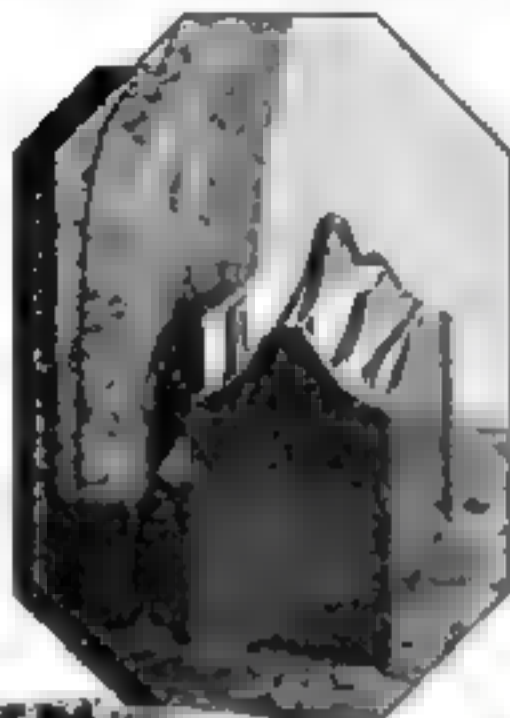
To assemble, apply good liquid glue lightly to the rabbet of one post and to the edge of a piece of wall board, which should be the same length as the posts (17 in.) and, if the rabbet is as shown in the accompanying drawing, $7\frac{1}{4}$ in. wide. The edges of the wall board should be cut parallel and square. Use short brads to fasten the wall board to the post. Repeat the operation with the other corner post.

It will help in attaching these parts to the back post to nail a piece of board about $4\frac{1}{4}$ in. wide on its edge on the bench. Upon this place the back post, face down. Then nail on the wall board from both sides, after applying glue. If both sides are the same width, they will not overlap.

The top and bottom are now bradded to the posts and the stops are glued in place. Fit a piece of cardboard loosely inside the case as a pattern from which to make two or three glass shelves. Double thick window glass is heavy enough, although plate glass is better. By rubbing the front edge of the shelves on a hard stone with some wet sand on it, the sharp corners may be ground off.

The door may be made as shown, with a raised panel, or a plain panel of wall board can be used if the case is to be painted. Another method is to rabbet the door stock instead of grooving it. This permits the use of a mirror.

The stiles and top rail of a door of this width should not be more than $1\frac{1}{4}$ in. wide, and the bottom rail 2 in. They will be $\frac{1}{4}$ in. thick to come flush with the face of the posts. Mortised and tenoned or doweled joints can be used. Hang the door with small butt hinges and add a glass knob and a friction ball catch.



Book, Trough and Magazine Stand

See LePage's Book, page 5



Old Salem Ship's Cupboard
See LePage's Book, page 5



Modernistic Folding Screen
See LePage's Book, page 12

12 NEW Job Plans, Too!

There is, of course, a limit to what we can give in LePage's New Third Home Work Shop Book for only 10 cents. But we realize many men want additional projects. Hence our 12 new Job Plans. These also were made by Mr. Klenke. They are projects that require more elaborate processes and that we can give in our book. Each Job Plan presents one project on a single large sheet of paper. Each is well worth your time and labor. Look over these projects and select those you want to make. See coupon on this page for 10 cents for each.

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- 21 Tea Wagon
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- 24 Modern Training Work Bench
- 25 Home Worker's Tool Cabinet
- 26 Spanish Sillcock
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BOOK

LE PAGE'S GLUE

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How to make your own Household Furniture LePage's Latest Book Shows How —for Yourself; for Christmas Gifts

LePage's latest book, the new "Third Home Work Shop Book," contains complete, easy-to-follow directions for making 20 attractive pieces of household furniture, of which, 17 are entirely new and never offered before.

This year the designs are divided into three groups. One group is based on famous old colonial pieces. Another group follows the furniture in popular demand in American homes of today. The third group is made up of modernistic furniture, showing the influence of the modern skyscraper set-back architecture of New York City. To buy 20 such pieces would cost about \$1,000. You can make them for a fraction of that, yet be the owner of truly fine furniture.

Designed by Expert

All the designs, dimension drawings, actual pieces and photographs were made by William W. Klenke, Instructor in Woodworking, Central Commercial and Manual Training High School, Newark, New Jersey. Also the designer of the first two LePage's Books. Each project and the directions for making it are perfectly practical.

Each project is presented in three parts—a photographic illustration of the finished project, a complete dimension drawing of its parts, and simple easy-to-follow, step-by-step directions.

In addition to the three pieces shown above, the book includes the following: Cape Cod Chest of Drawers, Alexandria Nest of Tables, Lady Washington Sewing Cabinet, Modernistic Book Shelves, Desk, Table, and Fire Screen, Smoking Table, Cased Side Chair, China or Book Cabinet, Magazine Carrier, Vanity Case, Hook Stand, Fernery Stand, Folding Sewing Screen, Plymouth Built-In China Closet, and Chess and Checkers Table. Where else could you get complete directions for making all these for only 10 cents?

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Simply use the coupon below, sending it to us with 10 cents in coin or stamps, and we will at once send you a copy of this latest LePage's Book, postage paid.

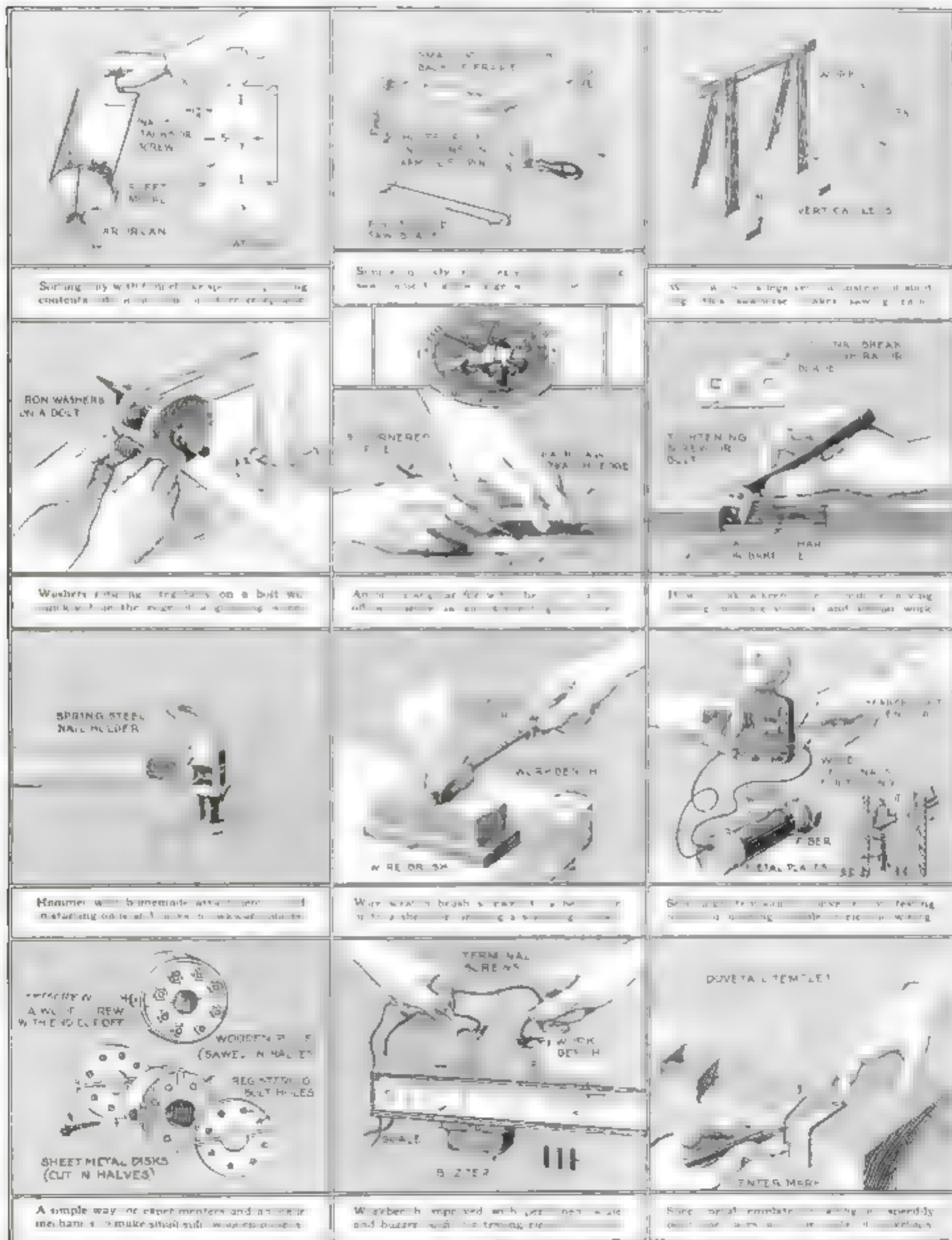
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610 Essex Ave. Gloucester, Mass.
Gentlemen: Enclosed please find 10 cents (coin or stamps) payment for LePage's New Third Home Work Shop Book. Please send a copy of this book to:

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Please also send the following Job Plans. (Indicate by number those you want. One column at left, for ones of which I enclose an additional 10 cents.)

Helps for the Home Mechanic



Puttying Windows

(Continued from page 84)

While this putty is also used for steel sash and gives first class results, red lead is considered even better. It is mixed with dry whiting or dry white lead in the same way as the white lead putty. It may be colored dark with dry lampblack, raw umber, or other dry colors.

For puttying sash you will need, besides a putty knife, either an old wood



Fig. 4. Razor blade in special handle for cutting off dry paint.

chisel for working on wood sash, or a steel wire brush (Fig. 1) for cleaning steel sash. Steel wool and No. 1 sandpaper are also useful on rusty steel sash. For the actual painting, you will require a round or oval sash brush (Fig. 2) or a flat sash brush about 2 in. wide. Some sort of brush for dusting is needed.

The preparation of wood sash requires the removal of all loose putty and the application of a coat of paint wherever the putty has come away. In working on steel sash, scrape off all loose paint with a putty knife or steel wool, and remove the rust with the steel wire brush and sandpaper or steel wool. Liquid paint remover also can be used to advantage when considerable paint must be taken off, as in cases where the inside of steel sash has been painted with flat wall paint without a proper priming coat.

The first coat on the bare metal of steel sash, always should be red lead and linseed oil, ready-mixed iron oxide metal paint, or other rust-inhibitive metal paint. Then the second and third coats may be any first-class paints such as are used for wood.

It is especially important to use rust-inhibitive paints for the first coat on metal sash in kitchens, bathrooms, basements, and rooms where moisture is present.

In double hung (sliding) windows there probably is only one rule that is generally followed by painters: the sash bars are painted first. After that the stiles (side-pieces) and the top and bottom rails are painted. The windows are usually painted while closed, no attention being paid to the surfaces covered up, such as the check rail in the center. The runways generally are not painted except the runway below the upper sash. When the sashes are moved much, the runways are oiled with boiled linseed oil.

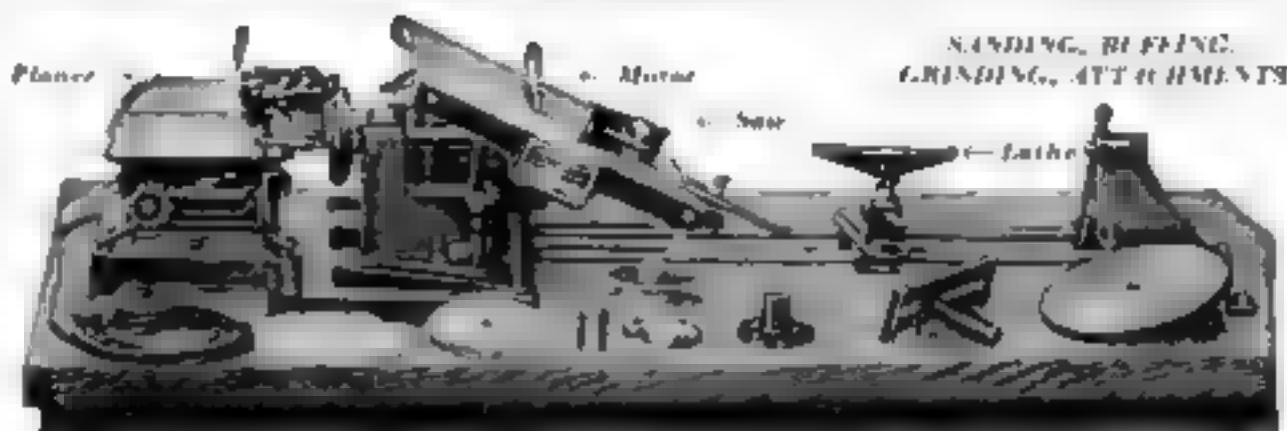
Casement windows, which swing out or in, should be opened and all edges painted. Then the sash bars are done and finally the face of the sash. While the sash is open, the window frame is painted. It is best to allow the windows to remain open while the paint is drying.

Whether one is painting windows, doors, wood wall panels, or furniture, it is usually best to do the center parts first, then the molded edges, and finally the flat surfaces.

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WORKACE Electric WOODWORKER

COMPLETE OUTFIT INCLUDING PLANER, SAW, LATHE AND ELECTRIC MOTOR AND MANY USEFUL ATTACHMENTS



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This is a COMPLETE all-electric shop to use at home or in business and it costs a lot less than most other outfits. You'll find the Workace fast and accurate for every kind of woodworking operation: planing, sawing, turning, drilling, grinding, sanding, buffing, etc. It saves time, does better and cleaner work, too.

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Materials and workmanship are 100% and the designing of the Workace is strictly professional. Woodworking plants, pattern shops, carpenter and cabinet shops all over the world use Wallace equipment.

The Workace Woodworker has power, strength and capacity to handle quickly and economically any job you'll ever want to do . . . mitering, tapering, rabbeting, beveling, slotting, turning, cross-cutting, ripping. Every unit works from the motor—parts are sturdy and well fashioned. The regular WALLACE GUARANTEE assures replacement of de-

fective parts for one year. Become an expert woodworker—make tables, chairs, stools, screens, lamps, lattices, fences, cabinets, doll houses, book cases, chests—make woodworking your hobby and turn it to profit, as hundreds do.

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Terms are all in your favor. Small down payment brings the Workace COMPLETE. Monthly payments so small you'll never miss the money

Many pay for their Workace out of profits it makes—so can you.

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Includes all this:
6" Planer
8" Circular Saw
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3" Emery Grinder
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1/2" H. P. C. F. Motor,
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4' and one 2' x V Belt
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PORTABLE MACHINES
The Planer and Circular Saw are each complete units and may be purchased separately at the correspondingly low price of \$75.00 each.

J. D. Wallace & Co.,
Walton and California Aves.,
Chicago, Illinois.

That Workace Electric Woodworker sure looks good to me. I want to know ALL about it, including your easy terms, right away.

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Address _____

City _____

State _____

Uses Metal Cover to Bank Fire in Heating Plant

MY HOUSE is a warmly built six-room cottage. A hot water system using by-product coke furnishes the heat. Six or seven years ago I adopted the plan of banking the fire at night with ashes. Then the thought came that a metal cover might be the best thing to use, since it would possess all the good qualities of the names and none of the bad ones. Going to a tin shop, I had a sheet iron cover made as large as could be pushed diagonally through the feed door. The shape of this cover was slightly oval. When in use it would nearly touch the boiler at the back and in front while at both sides there was an uncovered space of about two inches. That cover burned out the first winter, but the next year I had several covers made of heavier material, which I have used every year since.

We aim to keep the house heated at about the same temperature during the night as during the day, so, after banking that the plan worked well at night, I adopted it for day use also. During the winter weather, we find the temperature of the living room when we get up in the morning very nearly seventy degrees. I open the drafts, run an iron bar through the slaker door and slide it along over the grate to dispose of the surplus ashes. Throw in a large shovelful of coke, partly close the draft, and leave it that way for half an hour or more. Then I fill the hearth nearly to the bottom of the feed door and put on the cover. All doors, valves, and other openings are closed except the check damper at the top of the boiler, which is left slightly open. Under ordinary conditions the fire needs no further attention whatever until about eight or nine o'clock at night, at which time I go through the same procedure.

Coke has its volatile gases so removed that but little remains except pure carbon. With six inches of live coals on the grate, I can fill the boiler with this fuel, put on the cover at once, and shut off the drafts with no danger of explosion. Anyone trying this plan with any other kind of fuel would probably have to let the gases burn off more or less before placing the cover.—C. L. HILL.

Oil Rubbing Furniture

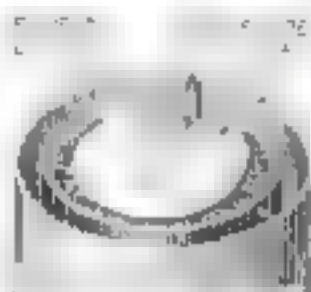
(Continued from page 107)

wood matches the oil and the entire piece has been well oiled, polishing can be started. Use any good grade of floor wax. Apply it with cotton cloth that has been washed and is perfectly free from lint. Rub the wax back and forth across the grain or use a circular movement. Continue rubbing until the wax has been rubbed in and both the surface and the cloth are almost dry. Apply more wax and repeat the rubbing. Continue until the grain of the wood is thoroughly filled.

Let the piece stand until the turpentine in the wax has evaporated and then give a final polish. A good rubber for this purpose may be made from a piece of wood 2 by 2 by 8 in., padded on one side and over all of the face edges with a layer of cotton from $\frac{1}{2}$ to 1 in. thick, and covered with strong cloth. Tack the cover to the back halfway up the edges and ends. Place over the rubber a loose cloth.

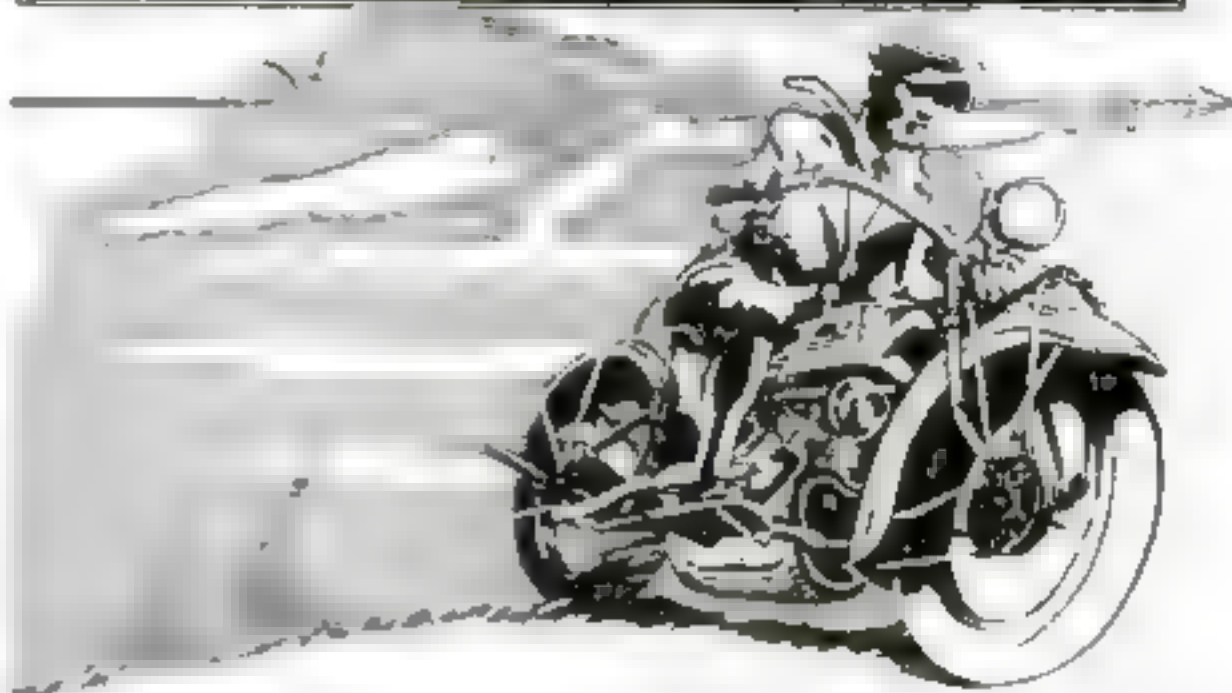
You will find the rubbing is strenuous exercise, but the result will be a polish to delight those who appreciate a beautiful patina.

In his next article, the seventh, Mr. Stanley will give more pointers on finishes.



Cutaway view showing the cover in place.

The NEW Indian 4



Give It Your Own "ROAD TEST"

Smooth, silent, quick on the pick-up, and quickly stopped. Here's an entirely new motorcycling sensation

Go to your dealer's, he'll let you take the new Indian 4 for a spin. Give it your own "Road Test".

Take one of the old familiar runs and just compare the performance and pleasure with any motor you have ever ridden. Give it a little more gas on the last fifty feet of that long hill and the surge of power that sends you over the top will make your sporting blood tingle.

See how smoothly you take the sharpest curves.—Low saddle position and weight close to the ground.

Braking power will be a revelation. You can stop quickly and smoothly. Added safety.

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Try traffic for a few minutes. Easy to

"lock-out" the clutch when you stop. Spring clutch foot pedal.

Sound the horn. That's a real horn, too. Pierces the air with a clear vibrating note.

Stop by the roadside and look at the improved construction. Strong, compact, and every part that should be accessible is accessible.

We'll be glad to send you by mail a handsome folder showing the new Indian 4 — every improvement is pictured and every feature is fully described.

P.S.M. 11-28

Name

Age

Address

City

State

Send folder on the new Indian 4, please. Also give name of nearest Indian dealer. _____ (check only if unknown to you.)

Mississippi Steamboat

(Continued from page 65)

See the inverted view of the stern on page 124.

A cut is made on the outside to the line B (shown on the side view of the stern, page 124). From aft to this line a fore-and-aft cut is made, leaving an upright sternpost on each side. Forward of this cut, the hull is rounded until the side is again vertical at 2 in. from the stern.

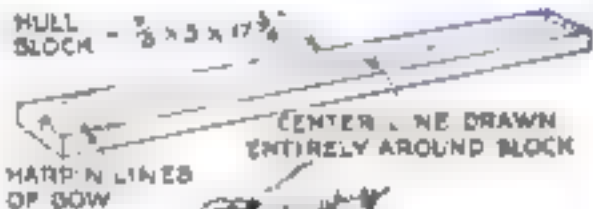
At $\frac{1}{4}$ in. from the outside edge of the sternposts, new cuts are made into the end of the hull almost as far as the lines B. In between them the wood is cut away to form a double curved arch, which is deepest at the center to conform to the line of the bottom of the hull. This is almost impossible to describe, but the lower photograph on page 54, the drawings below and on page 124 and the full size views in blueprints will give you an accurate idea of the shapes.

These cuts leave the two $\frac{1}{4}$ in. thick sternposts standing. The deck line is straight across to the outside edges of the sternposts. The two side botas project farther aft.

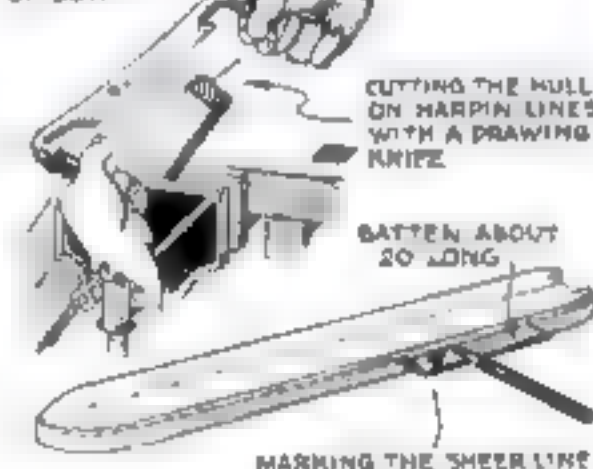
The stern (at the bow) may be left as part of the solid hull, but it is easier to cut it away and put on another piece afterwards. A very thin keel may be added, but it is so slight that I omitted it on my model so that the hull would be flat. A thin strip of wood or cardboard glued on will serve.

The hull is given three or four coats of flat white paint and two of black. The hull is then given a coat of clear varnish. After the ground work of flat white, I used layers of flat white on the hull. They dry quickly, and in this way a smooth finish is made on the hull is desirable.

Next comes the main (Continued on page 124)

HULL BLOCK - $\frac{3}{8} \times 5 \times 17\frac{1}{2}$ 

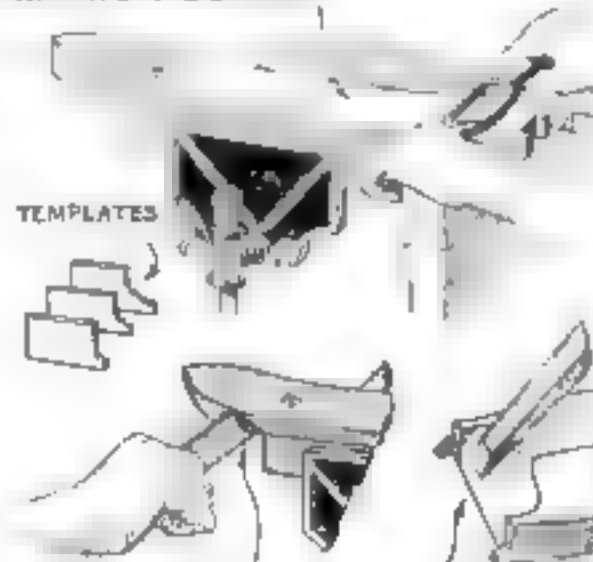
HARPIN LINES OF BOW



BATTEN ABOUT 20 LONG

MARKING THE SHEER LINE

CUTTING THE SHEER WITH A SPOKE SHAVE



TESTING OF BOW CURVES

SHAPING THE STERN

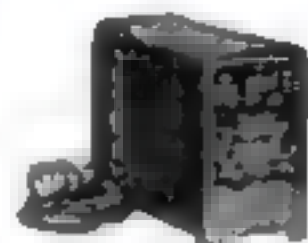
The hull is marked, the bow shaped, the sheer cut, and the carving completed.

Your Present Radio

... can be made an Electric A.C. Set *without changes in wiring or even the cost of new tubes*



Kuprox A.C. Power Pack. Makes any battery set an electric A.C. receiver. \$32.50 up.



Kuprox Multi-rate Rectifier. For trickle charging, dynamic speaker operation, etc. \$11.50



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DIFFERS no necessary for obtaining a good battery system. To get the convenience of A.C. operation, the new A.C. Power Pack converts any battery set into an electric set, without changes in wiring, without the use of harnesses or adapters.

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Several models are offered. One that supplies all radio power for any size set. Or separate filament and plate models for those who desire this form. And an efficient "A" model that supplies filament current and will operate in conjunction with any good "B" eliminator. Priced from \$32.50 up. See the various models at your radio dealer's. Or, if you first desire more information, we'll be glad to send it if you will write.

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Formerly The Kodal Radio Corp.

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Cincinnati, Ohio

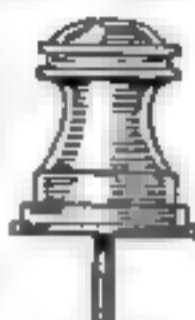
KUPROX

A.C. POWER PACK

Wood and Fittings as Aids to Model Ship Builders

TRIFLES make perfection but perfection is no trifle as makers of ship models know from first hand experience. Many a model that is beautiful in hull and spars is spoiled by the fittings being out of proportion or poorly made.

By using Boucher fittings you get a perfection in your deck that is almost impossible to make these tiny parts by



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1/2" Size 1/2" x 1/2" x 1/2"
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In this advertisement we have reproduced just a few of the scores of fittings that are available at Boucher, Inc. Our booklet, *Scale Models*, shows exactly how these fittings



are made. Materials of wood used in particular models. Boucher can supply your wood requirements in almost all cases. Below is listed wood required for a particular model with prices.

White Pine		
20x3 inches—1/4 inch thick	\$	70
40x3 inches—1/4 inch thick	\$	1 40
Holly		
20x3 inches—1/4 inch thick	\$	45
40x3 inches—1/4 inch thick	\$	1 90

Other Woods:

Write us if you desire some particular kind and size of wood and we will be glad to quote you a price, locate or cut to shape.

Send for Booklet "Scale Models"

This booklet—*SCALE MODELS*—has 12 pages of useful information for model makers. Contains history of steam engines, historical terms, letters, sketches and many other things of interest to model makers. Recommended for building up and perfecting model ships and hundreds of other ideas you will find useful.

Whatever type of ship—old or steam—ancient or modern—you are building, or planning to build, you will find the booklet *SCALE MODELS* of immense help. Send for today for your free copy. It is illustrated and contains many other things of interest to model makers.



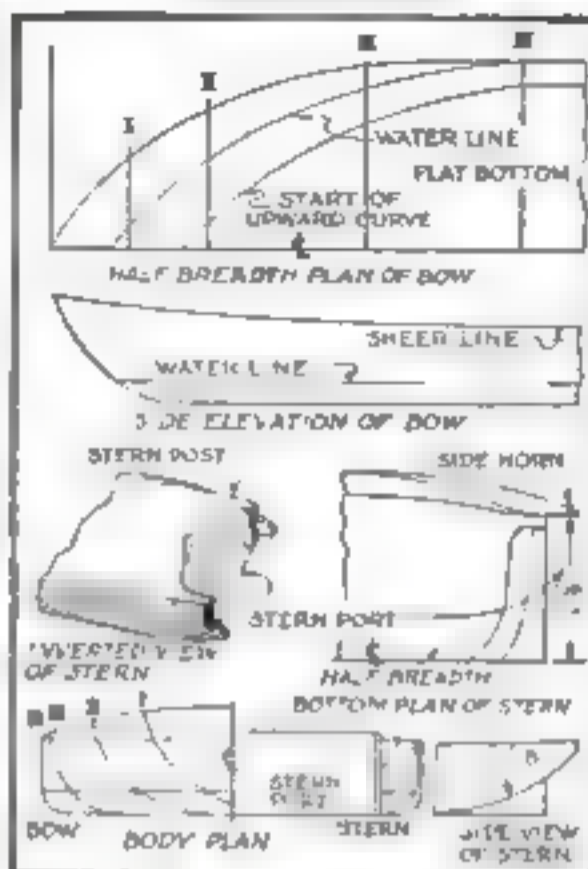
Enclosed is 15c for which please send me my copy of your 32-page illustrated booklet, *SCALE MODELS*.

Builders for Model Makers for 23 Years

Boucher Inc
100 Ave. Dept. SN N.Y.

Mississippi Steamboat

(Continued from page 105)

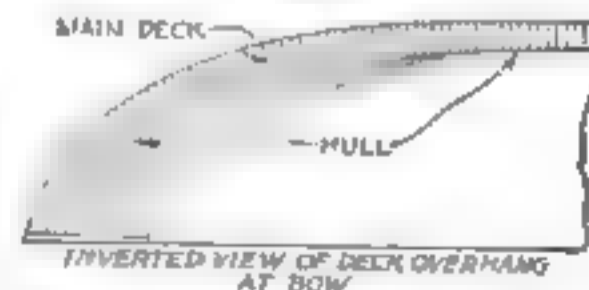
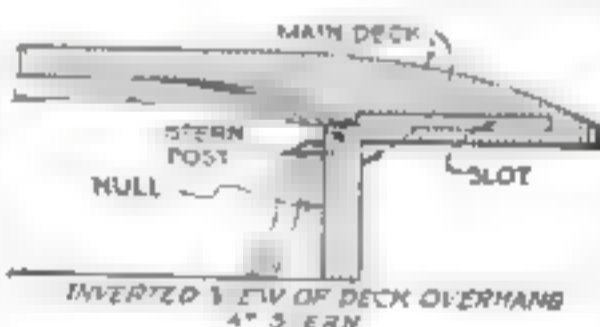


Bottom and side view of the hull showing the stern post and the stern view.

project accurately from the parts of the hull. The deck should be glued and tightly nailed to the hull.

Before anything is erected on this deck, lines must be drawn on it to represent the caulking between its planks. On such a model as this, I prefer to use a very hard, sharp pencil, but any not-too-sharp point will do if the lines are then penciled and lightly sandpapered. Some prefer to rub paint in and then sandpaper the surface down, but it is unnecessary work for this kind of model. The lines look best if from 1/16 to 1/8 in. apart.

From the after end of the engine house (to be erected later, the timbers will project to carry the wheel bearings. (Continued on page 106)



How the deck is prepared and slotted at the stern to allow the connecting rods to work.



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Anybody can master the science of chemistry with CHEM-CRAFT. Work hundreds of amazing and useful chemical experiments make soap, ink and dye, test acids, water and soil, produce startling changes and perform wonderful tricks of chemical magic. CHEM-CRAFT is the original and best chemistry set that gives thousands and thousands of fun. CHEM-CRAFT then your fun begins!

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If I had a workshop

Out in the garage, in the attic or downstairs somewhere, I'd have a couple flashlights handy there. Ready for the times when you need an extra-bright eye of light to help out. I'd have them, too, as a fire-prevention measure. Oil, waste and those odds and ends that always collect don't need much encouragement to cause a serious fire. Give me Eveready Flashlights and safety.

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Old Pliers Adapted for Holding Thin Pins



A piece of flat stock soldered to the jaws of the pliers aids in holding small round stock.

FROM a pair of old pliers with broken cutting edges and worn-out jaws a machinist made an ingenious tool for holding any length of round stock of small size for soldering, heat treating, and tempering.

After thoroughly cleaning the surface of the pliers, he bent over a length of flat stock and "sweated" it to the jaws as shown above. Then he drilled a hole through the flat stock to clear the work.

Wire or pins held with this tool do not slide around sideways even though the pliers are gripped only lightly—A. K.

Unusual Carrying Box Has Handle at One Side

ORDINARY tin boxes, in which various goods are packed, serve well as "take" or carrying boxes in the shop after they have been emptied of their original contents. Special boxes of this kind are illustrated. Each of these has only one handle, made by passing a length of strap through punched holes in the side and tying the ends.



Tin boxes with leather handles placed to allow two of them to be carried in one hand.

These boxes are used for carrying scrap parts from machines in places where it is impossible to push a truck. Because there is only a single handle on one side, one man can carry four of the boxes at once, two in each hand. The weight of the contents holds each pair of boxes close together when the handles are gripped and lifted.

Mississippi Steamboat

(Continued from page 124)

These pieces are 3½ in. long and are shaped as shown on page 124. They follow the deck sheer, slanting upward a scant ¼ in. The fore parts are firmly nailed and glued to the deck, then the after parts of the deck are bent up to meet them, nailed and bolted together.

A ½-in. molding is run right around this deck. The fore part must better be first sawed to shape, but the rest can be bent in position and glued and fixed with ½-in. pin points.

Nearly everything that has to be on the deck will have to be put in position before it is closed in with the deck above. Particulars of these fittings will be given next month.

Some who plan to turn the boat on a larger scale may want to make a working model of her. To do this the main deck should be in two pieces. One, an outer rim with all the superstructure erected on it, should be made to lift off, while the center portion remains fast to the hull and carries the engine and boilers, or whatever mechanism is used.

LATHES for the Tool Room—Manufacturing—Machine Shop—Repair Shop—Service Station

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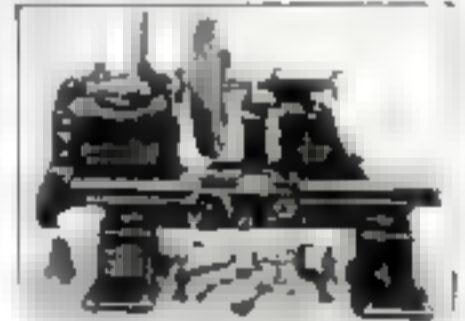
9" x 3" Junior Back-Geared Screw Cutting Bench Lathe \$150



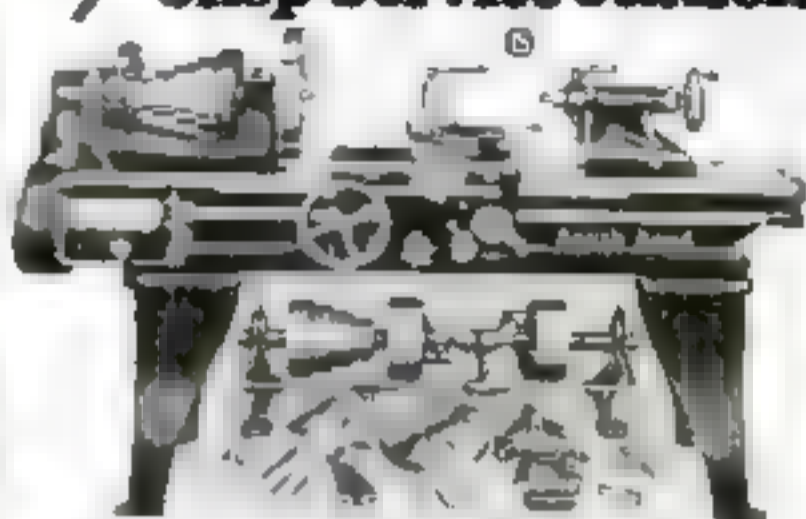
15" x 6" Standard Back-Geared Screw Cutting Bench Lathe \$335



18" x 8" Quick Change Gear Motor Driven Lathe \$908



Brake Drum Lathe
Handle all Brake Drum work without removing tire.
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No. 3 Lathe, Wheels to 42" dia \$600



16" x 6" New Model South Bend Quick Change Gear, Back-Geared Screw Cutting Lathe \$540

Other Popular Selling Sizes

The Prices of Popular Selling Sizes with Countershaft and Equipment

Size of Lathe	Shipping Wgt.	Standard Change Gear	Quick Change Gear
9" x 3	440 lbs.	\$235.00	\$270.00
11" x 4	725 lbs.	340.00	335.00
13" x 5	1110 lbs.	352.00	402.00
15" x 6	1500 lbs.	430.00	490.00
16" x 8	2035 lbs.	510.00	570.00

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The best proof of the quality and accuracy of South Bend Lathes is that they are used in production, tool room work and in general machine work by America's largest industrial plants. For Example, General Electric Co., Western Electric Co., Packard Motor Co., Oldsmobile Co., Houdaille Engineering Co., Victor Talking Machine Co., Black & Decker Mfg. Co., International Harvester Co., and in many departments of the United States Government.

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Fill in and mail to me without charge copy of 32-page illustrated book, "How to Get a U. S. Government Job," with sample envelope, list of positions obtainable, and full particulars telling how to get them.

Name

Address

Stuck Window Sash

(Continued from page 125)

and stile joints are easily broken, it should be avoided if possible.

2. Pry down powerfully on the outside of the window at the top, over the ends of the stiles (sidepieces). Use the chisel more gently to pry between the sash and the blind stops (the outside stops) on both sides.

3. In stubborn cases, remove the lower sash (see the following topic) and use a broad chisel to spring the parting strip as far as possible from the dado or groove in which it is fitted. This strip separates the upper and lower sash while they are sliding and makes the vertical joint as nearly weatherproof as possible.

How should one prevent a recurrence of the sticking?

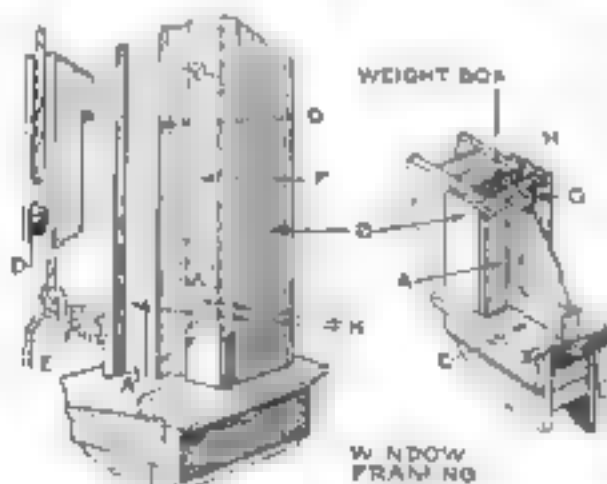
Plane the edges of the sash, either upper or lower, if the evidences of friction show that the sash is too wide. If they do not need planing, apply talcum powder or rub all surfaces which may stick with a paraffin candle or hard soap.

It is always best to do as little as possible to start a sticking sash, until you find out if a spell of dry weather will be sufficient to cure the trouble.—C. A. B.

How to Remove Upper and Lower Sash

HOW would you remove the lower sash of a double-hung window for replacing broken sash cord or glass?

1. Remove the left stop strip *A* by preference, as this will allow right-hand work. If the cord on the right side is to be repaired, however, the strip on the right side *A'* should be removed. Back out the screws and tap the strip lightly on the face or on the sash edge, not on the front edge, if the strip does not spring off when the screws are removed. Do the tapping on a small piece of wood to prevent hammer marks on the varnish or paint finish. Drawing a knife blade along the joint between the strip and the casing *B* will cut the surface fillet of the finish, if the tapping is not sufficient. If the strip is nailed on instead of fastened with screws, begin at the middle with a wide



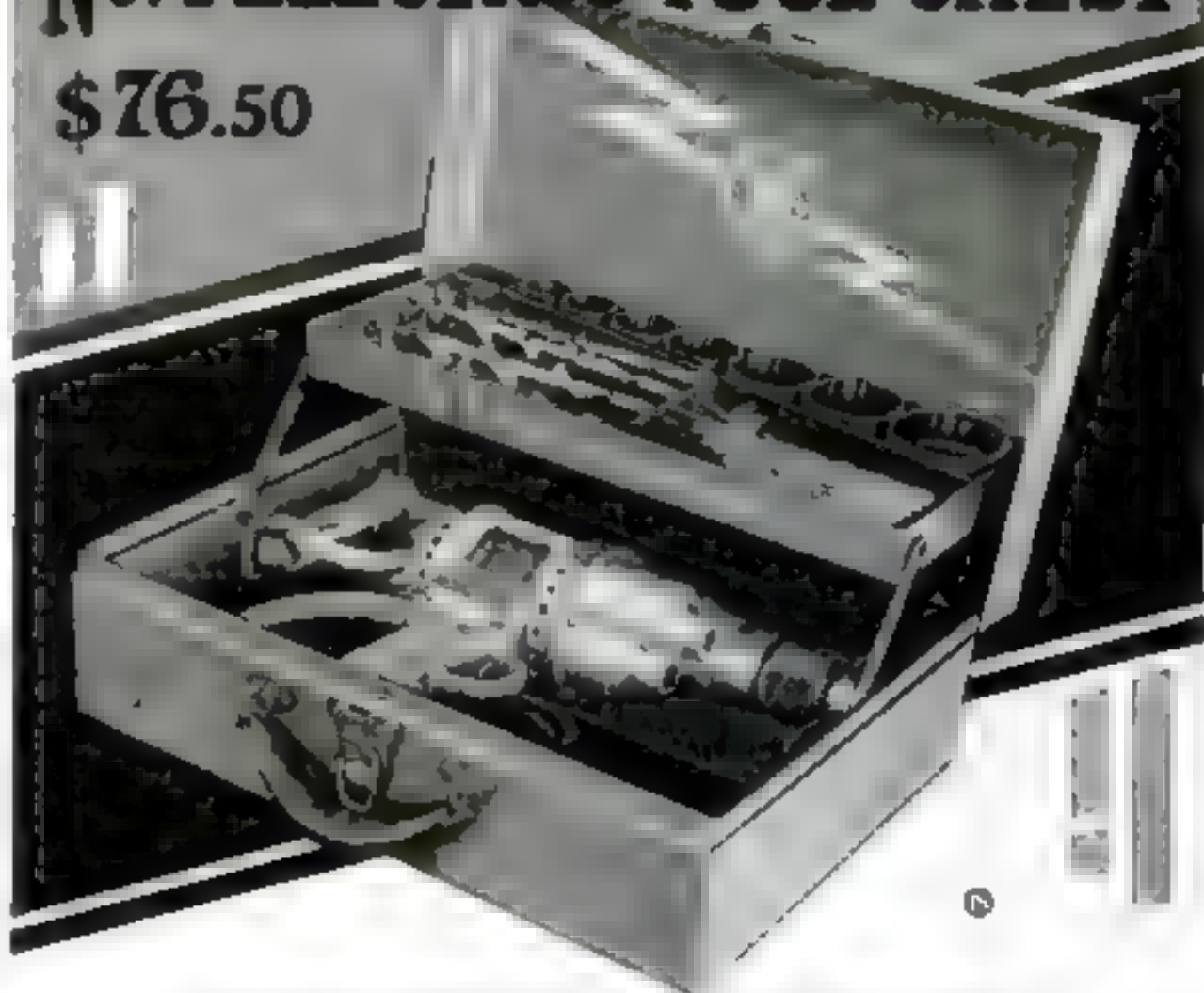
How a typical wooden window frame is made for a double-hung or sliding sash.

chisel and pry it carefully away from the casing. Because of the hardened putty or filler in the nail holes, it is best to pry the strip right off and either pull the nails out through the back or cut them off. Any attempt to draw the nails through the face is almost certain to mar the finish. Spring the strip out from the center, which will shorten it, and release the ends from the stool and the bender to prevent scratching the finish of the stool cap *C* and the head stop strip. (Continued on page 128)

BLACK & DECKER

No. 4 ELECTRIC TOOL CHEST

\$76.50



This chest comes in the famous Black & Decker Half-Inch Special Ball Bearing Electric Drill, twist drills from $\frac{1}{8}$ to $\frac{1}{2}$ inch, wood augers from $\frac{1}{8}$ to $\frac{1}{2}$ inch and Black & Decker hole saws from $1\frac{1}{2}$ to 3 inches. The hole saws are a special Black & Decker tool for use with the electric drill which enable you to bore holes in metal, wood, fibre, etc., up to 3 inches in diameter.

A serviceable metal tool chest with a Black & Decker Half-Inch Special Electric Drill in the lower compartment and the drills, augers and hole saws in an automatic tray which lifts up when the chest is open. This tray is sealed tight by the cover when the chest is closed, so that in any position the contents cannot spill out or get mixed up.

With this Electric Tool Chest you can bore holes in metal, fibre or wood from $\frac{1}{8}$ to 3 inches.

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A 50-lb. block of ice dropped on this icebox handle, bent the cast brass lever, stripped the screws out and splintered the wood. As larger screws could not be used and the lock could not be shifted, a new door seemed necessary. Instead the owner fitted the splinters back, filled the screw holes with about 5 cents worth of Smooth-On No. 1 and put back the screws. When the Smooth-On metalized, the lock became strong as new. The repair will last as long as the icebox.

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11-38

How to Remove Sash

(Continued from page 117)

2. Lift the sash above the stool cap and draw the edge of the sash into the room enough to allow the sash cord to be removed. Usually the cord will be fastened to the sash as at *D*. Pull the cord down to give a little slack, remove the knot from the hole, and unloose the knot or cut it off if the cord is long enough and is to be used again. Tie a slip knot as at *E*, and with a finger through the loop, allow the weight to pull the knot up until it stops at the pulley.

3. Remove the cord from the other side by the same method. The stop strip has to be removed from that side only if the weight there must be rehung. Then it has to be removed to allow access to the pulley in the pulley stile which usually is fitted as at *F*, so that it can be taken out to reach the weight.

How do you remove the upper sash?

1. Remove the lower sash as just described.

2. Lower the sash until it rests on the sill or as far as the cords will permit.

3. Remove the parting strip *G* from the groove in the pulley stile or jamb *H*. If the strip is held by paint or varnish, loosen it by the method described at the beginning of the answer to the previous question. Usually the left strip will be more conveniently handled. If necessary to pry it out, use a thin-edged chisel and pry carefully where the chisel marks will not be seen on the sash. Work from the part of the strip which you find you can loosen most easily.

4. Remove the cords as described for a lower sash.—C. A. B.

How to replace broken sash cord and how to put in a new pane of glass are the next topics scheduled for publication in the form of Home Workshop Reference Sheets.

Antiquing Ship Models

ONE of the hardest tasks for the beginner in ship model making is to give his handiwork the weatherbeaten appearance so often desired in models of galleons and other ships of the fifteenth, sixteenth, and seventeenth centuries. The method used by the writer in painting more than a dozen ships sold by him to friends and neighbors is as follows.

First paint the model the desired colors, using bright hues. Artists oil colors used in tubes can be used, although I have found small ten-cent cans of household paint serve very well.

Obtain a can of flat varnish, sometimes called "velvet finish" varnish, and a small amount of dry lampblack. Mix a level teaspoonful of lampblack in half a pint of the flat varnish. Add the powder directly to the varnish without first dissolving it in turpentine, as ordinarily would be done. Apply this mixture, thoroughly stirred, to the model and brush it well into all corners and angles. The small lumps of lampblack break under the pressure of the brush, giving a streaky, weatherbeaten, antique appearance.

With this method, it is not necessary to rub down the gloss, as the varnish itself is dull.

Models of clipper ships, frigates, whalers, barkas, and other relatively modern ships should not, of course, be antiqued, but the gloss should be rubbed off all painted and varnished surfaces.

As rubbing small parts is a tedious task, it is well to assemble a ship model (except the masts, sails, and rigging) and add all the deck fittings after they have been painted. Then spray the whole with flat varnish or lacquer. There are now many inexpensive spraying outfits—hand, foot, and electric—available for work such as this.—M. CLARK SMITH, JR.



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This book explains in a simple straight-forward manner all the principles of working with tools and wood. It takes all the mystery out of using tools and enables you to spend many interesting and profitable hours in your home workshop. All details are clearly explained.

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POPULAR SCIENCE MONTHLY
250 Fourth Avenue New York City

Trick-Performing Puppy

(Continued from page 80)

Select a well-shaped, well-preserved pane of medium size and secure the neck and feet in place with sealing wax such as is used in fruit canning. Only the wooden parts need be painted.

TO MAKE the funny man shown in Fig. 4, obtain a small round cardboard container for the body. Prepare the legs and feet and place the pivot for the legs about two thirds of the way up the side of the box.

An eightpenny nail will form the pivot. Two sections of lead pencil are used as spacers on each side of the legs. The arms are placed on the same pivot. The bottoms of the feet are slightly rounded to allow the toy to rock back and forth. Bright colors should be used for painting the finished toy.

When started down an incline of about 15 degrees, the little fellow, if properly balanced, should keep tottling until he reaches the bottom. Exact balance is the secret, this may be obtained by adjusting the arms to different positions.—F. C. H.

NEARLY every boy knows of the flying propeller. A novel way of spinning one of these is indicated in Fig. 5. If the roller is held at an angle, very long flights can be made, if held straight up, the propeller will go to a great height. The propeller must, however, be made small so that it will rotate rapidly. J. D. Grooms.

AN ALARM clock spring furnishes the power and common string and pins are used in the trigger mechanism of the staple but realistic model crossbow illustrated in Fig. 6. It will shoot "route" arrows with great force and surprising accuracy.

The stock is made from a piece of soft wood $\frac{3}{8}$ in. thick and 8 $\frac{1}{2}$ in. long. The top edge has a groove down the center for the arrow.

The pin upon which the looped trigger revolves is $\frac{3}{16}$ in. from the butt of the gun. To make the trigger, bend a small loop in about the center of the pin and drop some solder where the two legs come together. Fit the looped pin in a slot in the underside of the gun. One end (the end with the head) is the real trigger, while the other end moves the releasing pin up and down in a hole just its size. The releasing pin is just long enough so it will catch a tiny loop of wire on the bowstring.

The 12 in. long bow is a built-up spring with from four to seven leaves, depending on the kind of springs used. The leaves are bound with wire. CHARLES H. TAYLOR.

Repairing Ukuleles

WHEN a ukulele, banjo, mandolin, or similar instrument will not produce correct tones, I have found the cause to be almost invariably one of the following: Loose pegs, defective strings, frets not accurately placed, or nut too high from the fingerboard.

Common pegs are likely to slip after having been used a number of times; they can be enlarged by boiling them in water. If the pegs are of the notalip style and will not work, the lugs are stripped.

There is only one way to remedy defective strings and that is to buy new ones. If any frets are a thousandth of an inch out of place, discords often will be produced. This defect cannot be remedied.

If the nut is too high from the fingerboard, the strings, when pressed, will give sharp notes. It will be found that if the nut is filed down and new notches put in so that the strings are only a small fraction of an inch above the frets—but be sure they do not touch—an improvement in the tone production will be noted.—LEROY OLSON

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Monoplane Flies Indoors

(Continued from page 88)

the fuselage 3 in. from the rear end of the fuselage. Trench the points with cement.

The "ears" or rubber guides are of No. 8 piano wire. Make a ring about $\frac{3}{4}$ in. in diameter. Bend the ends parallel as shown and slip them over the fuselage. The front ear goes $2\frac{1}{4}$ in. from the nose, the rear ear, $8\frac{1}{2}$ in. from the nose. The ears are secured in place with a drop of cement on each side.

The wing has two spars of white pine, $\frac{1}{4}$ by $\frac{1}{4}$ by 18 in. These are sanded smooth. Soak the spars at the center and bend over a candle flame until the ends of each are 1 in. higher than the center. This forms the dihedral and makes the model stable in flight.

The ribs are bamboo, a scant $\frac{1}{4}$ in. square by $3\frac{1}{4}$ in. long. Curve them over a candle. The curve is $\frac{1}{4}$ in. high, and the highest part occurs one third the rib length from the leading edge. The ribs are bound to the spars with two wraps of silk thread each way, and are cemented. One rib is placed in the center and the others are spaced 4 in. apart, leaving a spar overhang of 1 in. to which the tip outlines are bound and cemented.

THE tip outlines are semicircular and extend $1\frac{1}{2}$ in. beyond the spars. Form them over a candle flame from $\frac{1}{4}$ in. square bamboo.

The wing is held securely to the underside of the fuselage by two clips made of No. 8 piano wire. The front clip holds the wing spar $\frac{1}{4}$ in. from the fuselage to give the necessary rib clearance. The rear clip holds the wing spar $\frac{1}{4}$ in. below the fuselage, thus giving the wing the necessary angle of incidence. Bend a loop in the wire and run the parallel ends up $\frac{1}{4}$ in. then downward and outward so that they will meet the spars $\frac{1}{4}$ in. each side of the center rib. Here they are bent parallel to the spars in a tight loop $\frac{3}{4}$ in. long and are bound to the spars with four or five wraps of thread and fixed with cement. Make the clips true so that the wing will be aligned properly, and do not have them grip the fuselage too tightly, as that might injure the stick.

Cover the tail, wing, and rudder with Japanese tissue, with rice paper, or even with soft tissue, although the last is not so strong. Stick the paper with banana on to the bottom side of the tail. Apply the adhesive along the chord and the tail spar. Work rapidly, as the oil dries fast. Trim off the margin, leaving an edge of $\frac{1}{4}$ in.

Cover the r. later in the same manner on one side only. Trim off the margin with a razor blade and give the tail and rudder a spacing coat of thin linum oil. It can be thinned with acetone.

COVER the wing on the top side, working out a section at a time. Pull the creases out lengthwise so the curve will be preserved. Trim away the margin and apply a coat of banana oil. As the oil dries, warp the wing in the hands until the left side has about $\frac{1}{4}$ in. greater incidence than the right. This is to counteract the torque of the large propeller.

The propeller is of the true pitch type. Select a block of very soft, light white pine, $\frac{1}{4}$ by $1\frac{1}{2}$ by 10 in. In the exact center of one $1\frac{1}{2}$ in. face locate a dot, and on the other $1\frac{1}{2}$ in. face place a similar dot. On each face draw two lines diagonally from corner to corner, crossing at the center dot. Draw parallel lines $\frac{1}{4}$ in. on each side of the center dot. This is to give body to the hub.

Cut along the outline to form the blank. Drill the center hole and carve out the propeller. It is cut so thin you can see light through it two thirds of the way to the hub. The cross section should resemble a wing curve. The convex side is the front side of the propeller.

After the propeller is carved, make a paper pattern of a graceful (Continued on page 136)

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Monoplane Flies Indoors

(Continued from page 135)

tip and then cut the tip to the pattern. Now trim the bulky part of the tip down quite thin. Be careful not to round the tips until after the actual carving is completed.

Measure up the rear edge of the blades $1\frac{1}{2}$ in. each side of the center hole and carve away toward the center until the hole is $\frac{3}{4}$ in. deep at the center. Sandpaper until the propeller is smooth, and balance it carefully.

The propeller shaft is No. 8 piano wire and, when completed, is 1 in. long. Bend a rubber hook on one end, pass the shaft through the center hole, and bend a tight loop in the other end. Force the tight loop into the wood at the hub to key the propeller in place. Touch it with cement. A very small washer could be cemented to the hub on the rear side. Usually you can get these washers from a clock repair man or a gunsmith.

The motor is three strands of $\frac{1}{2}$ by $\frac{1}{4}$ in. model airplane rubber.

THE model can, of course, be wound by hand and with this method can be safely given 300 turns, but you will certainly want to use a winder on it because by stretching the motor out to two and a half times its normal length you can give it 700 turns and get a much longer flight. Put a small V-shaped hook of No. 8 wire at the rear for use with a winder.

Winders may be purchased from model airplane supply houses. A small breast drill with a hook clamped tightly in the jaws makes an excellent winder.

To fly the model, pass a rubber band over the fuselage and under the wing to hold the clips in place. Adjust the wing until the model makes a smooth glide. The farther back the wing, the steeper the glide, but you want the model to make the shallowest glide possible without stalling, so adjust it accordingly. Wind the motor and launch it level and very easily. These models can be flown outside, but only in the quietest of breezes, as they are so light that any wind has a powerful effect upon them.

After you have gained experience with the simple and easily built white pine model and have seen what an excellent flyer it is, you will certainly want to make a very light, advanced model. Follow the same design closely but make the parts to the dimensions shown in parentheses on the drawing and, of course, substitute balsa wood for pine. You will be amazed at the results.

A WORD about balsa wood: It is lighter than cork and so soft that you will crush it in your fingers or cut it with thread if you are not careful. Have your knife sharp, otherwise you will make ragged cuts.

In making the model in balsa wood, the main difference is in the cross sections of the various members, as balsa is only one half as strong as white pine.

The fuselage is $\frac{1}{2}$ by $\frac{1}{4}$ in. balsa. Smooth it lightly with fine sandpaper and round the corners slightly. Give the stick a coat of banana oil. Prepare the wing clips, the propeller hanger, hooks, and cans in the same manner and of the same size as on the white pine model. For binding use a split silk thread. By untwisting the thread you will find it is made up of smaller strands. Use one of these smaller strands for all binding, partly because that will keep you from damaging the soft wood and partly because these wisps of thread are amp v strong. All bamboo parts are made in the same manner as the first model except that the cross section of the bamboo is $\frac{1}{4}$ in. by a scant $\frac{1}{8}$ in. The wing spars are $\frac{1}{8}$ by $\frac{1}{4}$ in. with the corners well rounded. When bending the dihedral in the spars, soak them well and heat carefully, as balsa takes fire easily and, once on fire, will smolder away. Also, the wood breaks more easily. (Continued on page 137)



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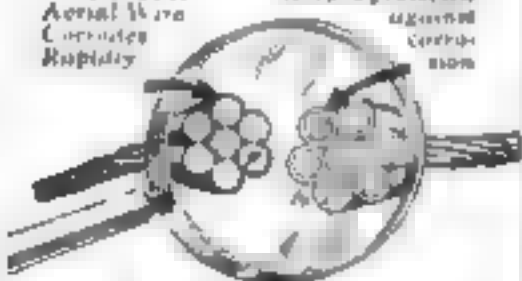


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Old Saws Help Make Garage Door Burglar Proof

MY BUNGALOW, which was not built with an eye to the confusion of intruders, has been entered no less than three times in two years. The vulnerable point was the door of a basement garage at the rear, held by inside bolts and a "tight" lock attached to the inside. The necessary clearance between the two doors made it easy for a burglar to insert a knife blade and slip the latch.

To make the door burglar-proof, I sawed two haups as shown from $\frac{1}{2}$ -in. cold-rolled steel plate. They were then hardened by heating them to a cherry red and dipping them into potassium cyanide, reheating and redipping three or four times until the hardening extended $\frac{1}{2}$ in. deep or more, so that they are file-proof and saw-proof. The padlock was protected by being chromium plated over the entire lock and U-bolt—and I don't think anybody will cut it with anything short of an acetylene torch!

Having gone thus far, I thought I might as well provide additional security at night when the family is in the house. So a bar was made from a piece of 2-by-4-in. pine, and heavy iron chests were bolted to each side of the door frame for this to rest in.

"No good," you will say, since it will be easy to cut through the bar with a saw inserted in the crack between the two doors. But—half a dozen back saw blades picked up in a machine shop eliminated that possibility. These are 18-in. blades of self-hardening tungsten steel, discarded from a power saw. One was nailed to the edge of the wooden bar, and two on each side, the nails being driven through the holes in the ends of the blades. Smaller blades and more of them might have been used if the heavy machine saws had not been available.—CLYDE HARRIS



Special haups and saw-reinforced bar

Monoplane Flies Indoors

(Continued from page 135)

For the outline of the tail use the same split thread as for bonding.

The propeller blank is cut from balsa in the same manner as white pine, but the hub should be $\frac{1}{8}$ in. thick instead of $\frac{1}{4}$ in. Cement the shaft in place well so the rubber will not pull the wire through the soft wood.

The balsa model is very much lighter and consequently will fly on two strands of $\frac{1}{8}$ by $\frac{1}{4}$ in. rubber. This motor will take safely 1,100 turns with the winder, hence the greater flying ability of the balsa model. The balsa model, of course, due to the delicacy of the parts, is somewhat harder to assemble.

The writers' white pine model weighed .38 ozs., the balsa model, .25 ozs. The white pine model under good conditions in an outdoor test flew 2,200 ft., remained in the air 100 seconds, and attained an altitude of 150 ft. The balsa model, with the power increased to three strands of $\frac{1}{8}$ by $\frac{1}{4}$ in. rubber to enable it to withstand better the outside air currents, flew 5,000 ft., and remained in the air 180 seconds.

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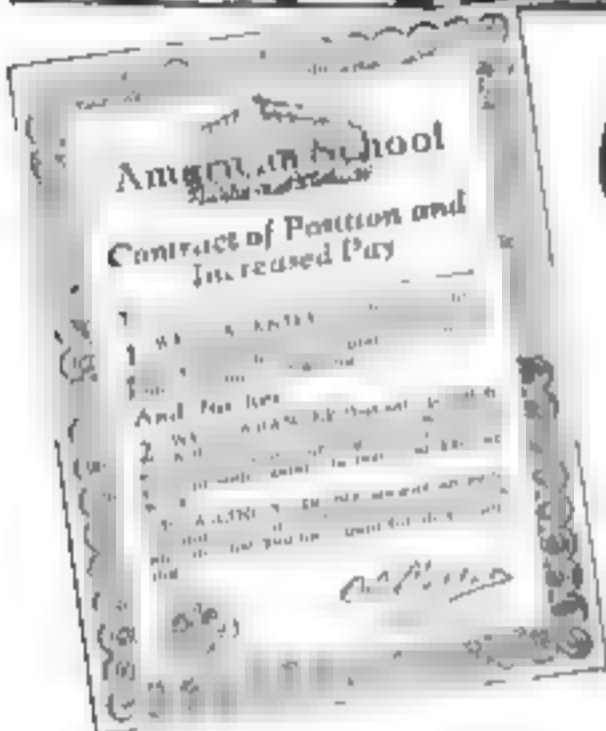
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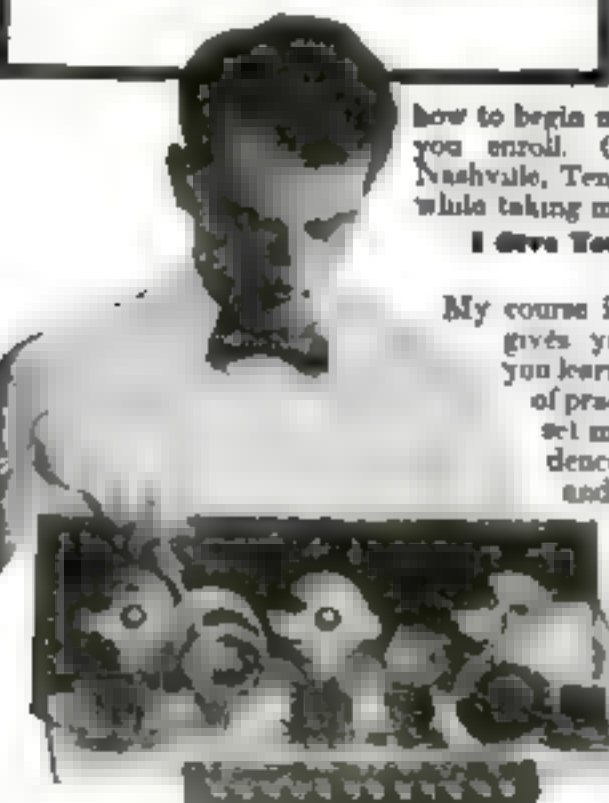
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How to Reverse a Motor

By GEORGE A. WILLOUGHBY, E. E.

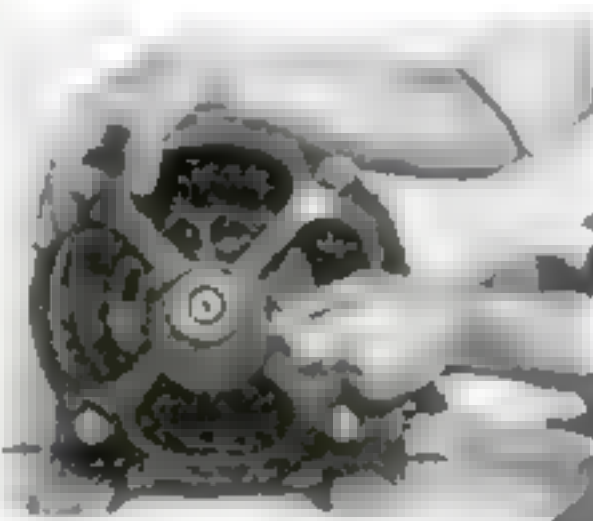
"SAY, George, I need a little help on a motor over at the shop. I wonder if you will come over and give me a hand. I've been making some changes and I want to use one of the motors in a different place, where it has to run in the opposite direction."

Anson, my machinist friend, was speaking.

"What kind of a motor have you, and what are you going to use it for?" I asked, as I got my hat and coat.

"Well, I don't know exactly what kind you'd call it, but you have to connect it to two alternating current wires, and it has brushes and a commutator. I bought it from a friend of mine some time ago and have never had any trouble with it except that it now sparks pretty bad when it starts."

"That's easy," I said. "It must be a repulsion-start induction motor and the



Cleaning the commutator with sandpaper held over the end of a small block of wood.

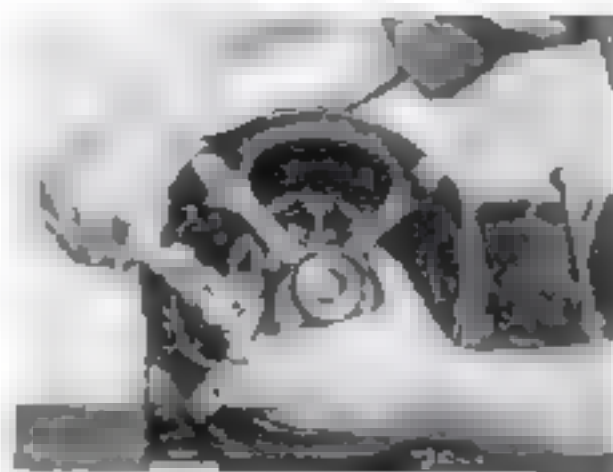
commutator probably needs a little sanding. We can take care of that."

When we reached Anson's shop I could see that the commutator was dark and covered with carbon dust from the brushes, just as I had surmised.

"It's a snap to reverse this motor," I assured him. "Just give me a wrench that will fit the head of this bolt clamping the brush holder in place. All we have to do is to loosen it and move it up to the top of the slot, and then perhaps move it back a little if the brushes spark after the commutator is clean and the brushes fit it." This adjustment was quickly made.

"Now give me a little block of wood and some fine sandpaper," I said, "and I'll show you how to sand the commutator as soon as you have the motor running."

With the sandpaper pulled over the perfectly smooth end of the block, I held the paper in contact with the commutator until it was smooth and bright. If the sparking had continued after this, I should have adjusted the brushes a little and fitted them to the commutator by lifting them, placing the fine sandpaper with the smooth side against the commutator, and working the armature back and forth by hand so as to remove enough of the carbon to make the ends of the brushes as smooth as possible and of a



Moving the brush holder of a repulsion-start induction motor to reverse the rotation.

shape to insure good contact with the commutator.

"Well, I'm much obliged for your help," said Anson, "and I don't want to ride a free horse to death, but there is one more thing I would like to have you show me before we go back. I wish to reverse this three-phase motor over here."

"There's not much to that," I replied as I picked up a screw driver. "You can do that by interchanging any two of the three lead wires. Perhaps the easiest place to get at them is right here at the switch. You can just as well do it right now. Take the wire from the second terminal and leave it until you disconnect the first and put it in its place. Then connect the second wire where the first was."



Reversing a three-phase motor by interchanging two of the lead wires at the switch.

Repairing Grease Cups

THE threads on the lower or bearing end of small grease cups wear in time to the point where they easily become crossed upon applying the cup. The chances are then greater of the cup's being loosened by vibration and becoming lost. Lay the worn part over the peen

of a hammer as shown and strike it with a block of hard wood. This will expand the thin, tough metal of the cup quite evenly and as much as needed, in this way giving the grease cup a period of usefulness.

—F B.



The cup is expanded over a hammer head.

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Employs New Principle

Revolutionary in principle as well as in price, ADDOMETER has been acclaimed by experts the neatest, most compact and remarkable adding machine ever invented. It works entirely without the use of keys or awkward levers. Yet it is lightning fast and never makes a mistake. Shows total always visible. It

clears instantly. Every action is simple—direct—automatic. Anyone can operate it like an expert in 5 minutes' time!

But that's not all! ADDOMETER is also radically different in design. It is made entirely of metal—embodies a host of astonishing features. Only $1\frac{1}{2}$ " long, 2" wide and $\frac{1}{2}$ " thick and weighing but 14 ounces, it can be carried anywhere, right in your coat pocket. Fits right over the sheet of figures being computed, keeping your place, preventing troublesome eye-strain, speeding up your work. You've never seen or heard of anything so amazingly practical!



Equip all your employees at small cost.

A Machine Everybody Should Own

ADDOMETER performs a useful, necessary service in your daily life. Does all your figuring for you quickly and accurately. Eliminates mental strain, prevents costly errors, saves you time and money every hour of the day. Even if it sold for \$100 or more you shouldn't be without it! At only \$10 you couldn't buy a handier helper. Yet that's all ADDOMETER costs—and you needn't pay a penny until you've used it for 10 days!

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NOTE: ADDOMETER is made in 3 models. Every machine fully guaranteed. Fractional Decimal Model A (described in this announcement) costs \$9.95. Ideal for general use. Standard Decimal Model B costs \$10.00. (No fractions). Designed for selling whole and very large numbers. Fractional Decimal Model C costs up to \$20.00. (No fractions). Particularly valuable to architects, etc. Be sure to indicate Model desired.

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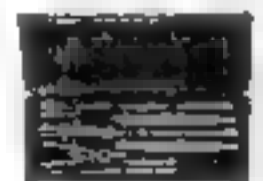
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Charles E. Fitz, M. E., E. E., formerly associated with Steinmetz, says: "I am amazed at how clearly and simply you explain the facts about electricity. The points are so much easier to grasp than by the usual methods of instruction that the student must make quicker, surer progress. Your whole course seems to me by far the best method of getting thorough preparation for practical electrical work."

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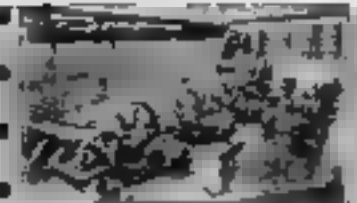
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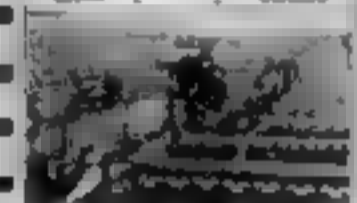
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Power unit in
factory



Power unit in
factory



Power unit in
factory



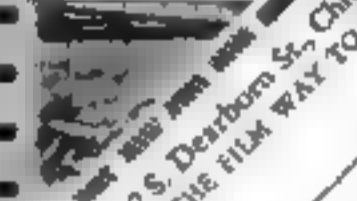
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Solving the Mystery of Twins

(Continued from page 247)

Eleanor was adopted by a family living at Bay City, Michigan. Neither sister saw the other or knew of her until a few months ago when a woman thought she recognized Georgiana on a South Bend bus. In reality it was Eleanor. Explanations followed and now Professor Horatio H. Newman, distinguished biologist of the University of Chicago, is studying the case, which is of intense scientific interest because only the hereditaries of these children were alike. Their environments have been different almost since birth.

At the University of California, Professor H. E. Jones is setting up a "twin laboratory" for a most searching study. Apparatus will be provided for the exact measurement of all bodily and mental characters. No less than five hundred pairs of twins will be studied, from birth until adult life, if possible.

PROFESSOR JONES will include not only identical twins but some of those who are not so remarkably alike. How does science explain these, some of whom lack even the usual family likeness? These so-called "fraternal" twins are not really twins at all, in the sense of having sprung from the same original cells. They are merely ordinary brothers or sisters who happen to have developed simultaneously but from two distinct fertilized egg cells. Here there are no mental or bodily similarities more marked than between other members of the same family.

Among triplets and among those still rarer individuals who enter the world in groups of four, five, or more at the same birth, there probably exist the same two types as among twins. Some of the triplets and quadruplets are distinct individuals, whose separate germ cells merely chance to develop together. Among such are the famous Keyes quadruplets of Holts, Oklahoma, girls of fourteen, three are dark-haired while the fourth is a blonde.

That others exist of the more interesting identical type is proved, however, by the Hanna sisters of Kansas City, triplets who at eighteen are as much alike both in mind and body as any two identical twins by the Waggoner brothers of Union County, Tennessee, triplets who looked exactly alike throughout lives lasting over seventy years, and by numerous instances discovered by Dr. R. A. Fisher, of Rothamstead, England, in a recent study of 100 cases of English multiple births in 1924, 1925, and 1926.

TRIPLETS and quadruplets have been less studied scientifically than twins for the simple reason that they are so much rarer. Over the whole earth there is probably about one pair of twins for each two hundred ordinary births, one trio of triplets for each six thousand births, one set of quadruplets for every million births, and one birth of five children for every twelve or fifteen million births. Medical records contain a dozen or so instances of six living children born at once and two somewhat doubtful instances of seven.

Among other puzzles of heredity which the studies of twins and triplets are expected to help solve is whether the propensity to have twins is itself hereditary. Probably it is, physicians are sure at least, that some parents are more likely than the average to increase their families by twos. Four sets of twins in one family as far as is known, is the American record, jointly held by at least two families, while five pairs have appeared in each of several families in other parts of the world.

"HOW can he do it?" we always want to know whenever a magician performs some thrilling new feat. In a forthcoming issue an expert explains many magical illusions which have mystified us most. You won't want to miss this fascinating article.



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A definite program for getting ahead financially will be found on page four of this issue.



How I Started Making \$5300 A Year With a Borrowed Kriss-Kross Stropper

The True Story of A Man Who Found Himself Facing Failure And Then — by a Sudden Stroke of Luck — Discovered The Secret of Making Over \$5000 A YEAR! Don't Fail to Read This Illuminating Article of Real-Life Success! It Should Prove An Inspiration to Any Man Who Wants to Make More Money!

By B. G. LOUGHREN

"\$200 the first week! \$1000 in a single month! And over \$5000 cash profit in a year!"

When I sat down and looked at those figures in my bank book, I can't help marveling at the strangeness of fate. It was Chance — and Chance alone — that thrust this money-making opportunity into my path at the very moment I needed it most. I had been in the real estate business in Florida when suddenly the boom collapsed! The immediate future looked gloomy and one day when I dropped in to talk things over with a friend

When I went into his office, he was at the wash bowl just finishing shaving. So I sat down at his desk where my eye fell on a little nickel-plated contrivance about the size of my hand. There was something about it that aroused my curiosity.

NEW, REVOLUTIONARY INVENTION

"What's this thing?" I asked.

"That's one of those KRISS-KROSS razor stroppers," said Jimmie. "You've read about it in the newspapers. I've only been using it a month but I'm getting the keener shaves of my life from the same blade. Look here, I'll show you how it works."

Well, it certainly was a mechanical marvel. I hadn't seen anything so ingenious in years.

"I wish I could invent something like that," I said. "I'd bet the company that put it out is making money hand over fist."

"They are," said Jimmie. "Furthermore, they only sell through agents and demonstrators, and those agents are making plenty, too! I went for their proposition the other day just out of curiosity."

He handed me a letter with some sample order blanks attached. I read it through and then read it all over again. "Jimmie, I said at last, 'this thing sure will sell' — and they certainly give their men a good straight. Let me borrow your stropper this afternoon and see how many orders I can take!"

ASTONISHING PROFITS

That afternoon I got the surprise of my life. The first man I walked up to had read all about KRISS-KROSS in The Saturday Evening Post and said: "Send me one — before I get half way through my demonstration." By 4:30 I had 9 orders and the next morning I got 11 more!

That sure convinced me — and I wrote the company that

although they were not aware I was working for them, the only way they could stop me was by wire! They wrote back: "Good work, G. L.!" Needless to say I went to work in earnest and the end of the week found me with steadily \$200 cash profit in my pocket.

A \$15,000 BUSINESS ALMOST OVER NIGHT

The money I made that first week came easy enough — but after I got well started it became easier and easier. And then, before I knew it, I found that I was actually clearing as high as \$1000 in the single month!

To-day I figure that I did a \$15,000 gross business that first year with profit of over \$4000. And it all came from getting started with the right kind of a proposition. Success comes from giving the public what it wants and they surely have shown that they WANT KRISS-KROSS. Personally, I believe that it is the most astonishing "self-seller" I have ever seen and that the coming year will prove it the greatest direct-selling item of all time!

My Loughren experience is typical of the surprising success of KRISS-KROSS representatives in all parts of the country. Practically every man finds himself making money faster and easier than he ever dreamed possible. Right now due to our heavy Fall advertising program in Liberty, The Saturday Evening Post, Colliers, etc., there is room for more KRISS-KROSS representatives — to earn \$20 a day and up. Find out about this opportunity to-day. No obligation. Just clip the coupon and mail it at once!

Rhodes Manufacturing Co.

Makers of KRISS-KROSS

Dept. 3-241, 1418 Pendleton Ave., St. Louis, Mo.

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How would you like to make \$20 a day and up with generous commission proposition you offer to representatives and agents, working full or spare time.

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KRISS-KROSS actually reproduces with mechanical precision the intricate diagonal stropping stroke of a master barber. Stropps any make blade except Durham Duplex, giving the keenest cutting edge that steel can take! Just insert blade and turn the crank for 11 seconds.

How can anyone help but be interested in such an amazing device, especially since it means cool, smooth shaves forever with no more blades to buy!

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You will like the course because it is so **PRACTICAL**. You work on actual blueprints—the same blueprints a contractor would use if asked for an estimate, or a foreman would receive from a contractor.

In a surprisingly short time you can acquire a knowledge of blueprints that will be of great value to you in a salary way the rest of your life.

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| <input type="checkbox"/> Architectural Power | <input type="checkbox"/> Biological Engineering |
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Colors We Can't See

(Continued from page 150)

can be done by holding a card on its edge between the eyes and along the nose, so as to keep one eye from seeing in the other's field.

Strange as it may seem, we don't see simply yellow and blue. We see a kind of white, or else we experience a rivalry between the two colors, as if one were trying to blot the other out. What happens is that the eyes attempt to see the two colors as one. If they succeed, in the case of the yellow and blue, the resulting sensation is white.

It seems quite plausible, then, that yellow and blue themselves might have originally come from white. And this is exactly what the new theory says. If, now, we try to see red and green at the same time, we see yellow instead, or else we get the same rivalry between the colors. And so, again, it seems plausible that red and green might have come from yellow in the evolution of color vision.

DR. LADD-FRANKLIN explains that the mixing of the colors in the above experiments occurs probably in the retina of the eye without our being aware of it, and is a chemical process. A ray of light, falling on the retina, is believed to decompose an unknown substance in the rods and cones, producing chemical action that gives us color sensations.

Studies of the spectrum, or artificial rainbow, indicate that with perfect eyes we ought to see at least 165 basic colors. Actually we see only the four—red, green, yellow, and blue. Why is this?

The answer, says Dr. Ladd-Franklin, is that the mechanism of the eye takes a short cut. Through the process of splitting up and reuniting it substitutes for the potential 165 different colors a bare four—four together with certain blends of these four. If our eyes were capable of distinguishing more lines—as some cameras can pick up more wave lengths than others—then we could begin to see more of the basic colors. A moment of figuring will reveal how much better eyes we need. If we now see only four primary colors, and if 165 exist, then we are only about one fortieth of what the world really provides! It is an amazing deficiency.

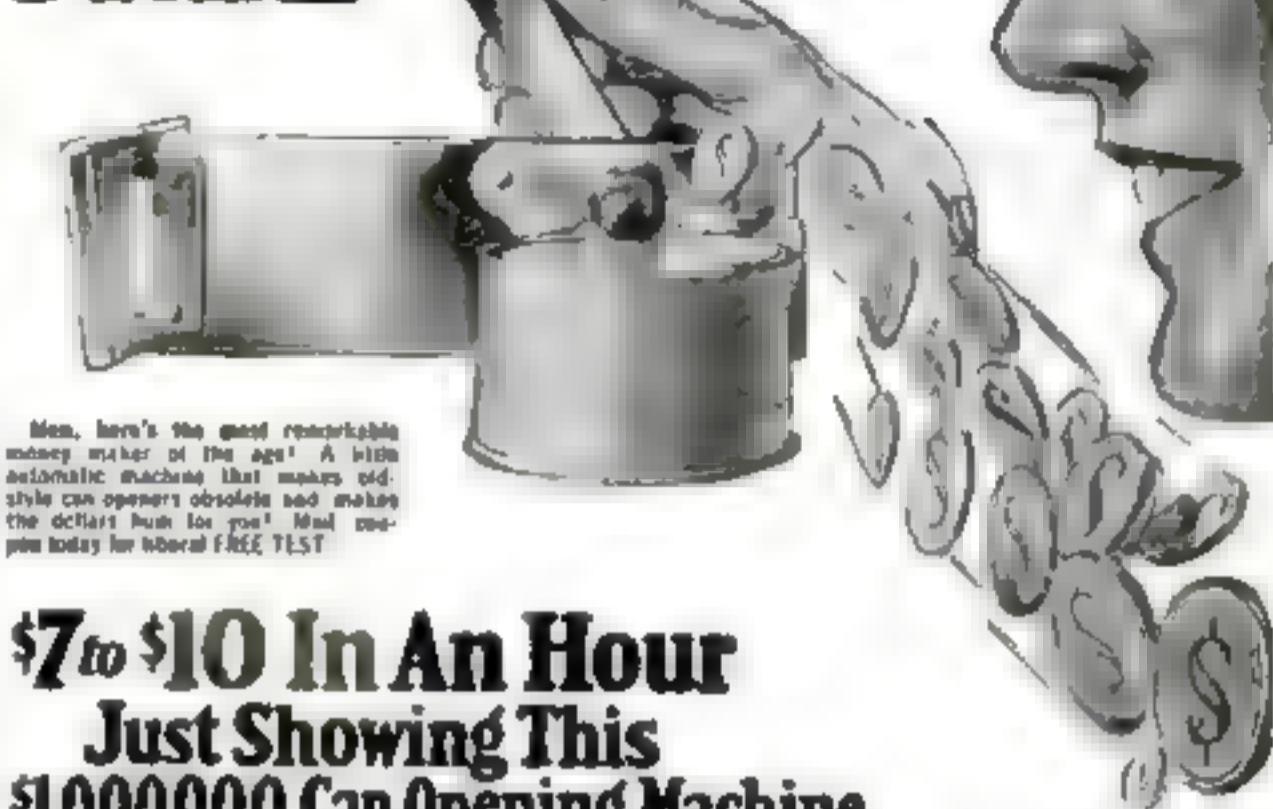
As we are, we can hardly distinguish between two color blends such as two blue-greens. Yet there are about forty different shades between those two. If the process of evolution in the eye goes on indefinitely it may be that eventually man will see on every scale a display of colors such as would dazzle us beyond belief. He will then look back upon us as we now look upon the cat, and pity us for the drabness of the world of sight in which we lived.

Big Guns Traced by Air Puffs

HOW British scientists used the faint air pulses from German guns to locate and destroy them was told the other day by Sir William Bragg to the British Association for the Advancement of Science. It was a problem, he said, of finding some way to time the arrival of the pulse simultaneously at several points, so that surveying experts could locate the gun and give British artillerymen the range.

A British technical officer, listening to nearby firing within his battered hut, noticed that reports often were accompanied by a faint whistling, as of air rushing through the wall's cracks. He conceived the idea of making "electric thermometers," containing hot wires that would be chilled by the passing air wave. When they were chilled, the altered electric current would register on a delicate recording instrument. The method was tried, and proved successful, the firing of a big gun miles away chilled a wire perceptibly. Sir William revealed that the officer-inventor was his own son, Prof. W. L. Bragg, of Manchester.

Test This Amazing Money Making Invention FREE



Men, here's the most remarkable money maker of the age! A wide automatic machine that makes old-style can openers obsolete and makes the dollars rush for you! Read coupon today for liberal FREE TEST

\$7 to \$10 In An Hour Just Showing This \$1,000,000 Can Opening Machine

NO more awkward stabbing and hacking with old-style can openers! No more danger of blood poisoning from gashed and lacerated fingers! For now a remarkable new invention handles every old-style can opener to the scrap heap. Now a simple twist of the wrist opens any can in a couple of seconds. No wonder they all simply go wild over it. No wonder salaried men often sell in every house in the block and make from \$7 to \$10 in an hour!

Works Like a Charm

This queer little device doesn't just chop a ragged hole in the top of the can. It cuts the entire top completely out clean as a whistle! The machine holds the can—opens it—flips the lid so you can grab it—and gives it back without any sharp edges to snag your fingers. You just put the can in the machine—turn the handle and almost instantly the job is done!

Sells Itself in 10 Seconds

Everyone knows how women detest the danger-

ous old-style can opener. Imagine, then, how they welcome this startling new method this automatic way of doing their most distasteful kitchen task. Men, honestly I'm not exaggerating one bit when I tell you that not ten words are necessary to sell any of them! All you do is hand your demonstrator to your prospect and let her try it. She sells herself in ten seconds by the clock—and you pocket a nice fat profit. Yes, really, it's just that simple and easy! That's why \$75 to \$150 a week is easy anywhere.

Opens any Can in a Jiffy



You just slip the can in the holder and turn the handle. Nothing complicated, nothing to get out of order—opens any can square round or oval in a few seconds. And, men, IT'S TRIPLE PATENTED so there is no competition.

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Triumphs over Friction

(Continued from page 148)

which "oilless," self-lubricating bearings can be made. In the journals of railway cars, stuffing boxes packed with oil-soaked waste keep friction at bay.

Yet friction is not wholly a villain. You would miss it sorely, if by some miracle it were abolished. You could not step without fear of falling, for your shoes would act as if you had stepped on a banana peel. Pocket matches would cease to light when you struck them. You might achieve the dream of a perpetual motion machine—but you could not transmit its power by a belt, for the belt would slip.

IN YOUR car, friction is put to work to grip the road through antiskid tires and, at your command, stop the machine through fireproof asbestos brake bands. Iron grates on iron in the brakes of a speeding train. It would take twenty laborers seven days to accomplish as much work as the brake shoes do in a few seconds in stopping a thousand-ton express train speeding sixty miles an hour, and the heat generated at the brake shoes would cook twenty dinners for the men.

That accounts for what happens to the energy industry used up in freeing its shafts from friction's clutches. It turns into heat. If you could keep the heat from escaping, you could boil water by stirring it. If you wished, you could even heat your house by friction! Years ago a machine was built, at Northampton, Mass., to do that very thing. Two horizontal, circular plates of cast iron, four feet in diameter and weighing 1,600 pounds, rotated upon each other within a brick oven. An account published in the New York Sun of January 7, 1884, said of them, "The ordinary speed, eight revolutions a minute, is sufficient to raise the temperature in the oven to 500 degrees within two hours. A funnel from the oven will convey the heat into any room."

The squeal of automobile brakes and the screech of trolley wheels rounding a curve tell where more of friction's energy goes. As noise, it echoes in waves through the air—and finally they, too, turn into heat. Only the other day, two experimenters, Dr. R. W. Wood, Johns Hopkins professor of physics, and Alfred L. Loomis, of Tuxedo Park, N. Y., succeeded in burning a hole through a chip of wood with sound waves concentrated in a thin glass rod.

WHAT causes friction? Really there are two kinds. The most familiar is that of rubbing surfaces upon each other. If you look at the apparently smooth surfaces through a microscope powerful enough, you will see that they are not smooth at all, but covered with innumerable points and hollows. As they move over each other, the projections of one, where they become caught in the hollows of the other, are continually bent aside or torn off. That takes force, and the force is friction. That is why rubbing surfaces in machinery are made of unlike substances, such as steel and bronze, whenever possible, so there will be less chance of the projections on one fitting into depressions of the other.

The second kind of friction is "internal;" it happens inside soft metal when you bend it, or inside water when you stir it. Strains set up between layers of which the substance is made oppose the motion and cause internal friction. That is why wire gets hot when you twist it.

Liquid friction is much less than that of solids. Therein lies the secret of why oil lubricates. A few drops between two rubbing metal surfaces form an "oil sandwich." Its outside layers are two thin oil films—one on each surface. They adhere so strongly to the metal that tons of pressure cannot squeeze them out. Between them is the "filting"—a free-moving, liquid layer of oil. When the metals rub, oil slides on oil instead of metal on metal, and you have substituted the minor evil of fluid friction for the grating, harrowing friction of solid metal.

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Young Jim

(Continued from page 25)

sweat-streaked scarecrow supplied. "Jim Durkin," thrusting out a dirty hand. His teeth were bared in a friendly grin—the only white spot on him—and he spoke quietly, as usual. "Pete told me where it was," he went on at once, "but my ears must be full of dirt, I couldn't understand him."

Slug Williams looked him up and down, threw a sidelong glance at Sam—and made a sort of a choice. He reached out and shook the hand limply. "Gonna stick around, are yuh?"

It was a choice, though most reluctantly made, such was plain to be seen. He did not get to his feet, neither did he smile except for a drawing down of the corners of his mouth, and the question he asked was packed full of a skepticism that was dangerously close to insulting. There it was—the antagonism of a lazy, narrow-minded man, and Sam knew a fear he had never felt before. The Old Man a son was up against something more than a hard job.

J. ORCUTT knew it, too. His grin disappeared for a moment, though he continued to regard Slug with steady eyes in which there danced that unquenchable fire. Then his teeth showed again.

"Yes," he replied. Slowly, almost thoughtfully. "I believe I will, after which he returned to the question at hand. "Where dat you say the coke house was?"

And that was that. The joking was finished; a very serious business was to follow. Moreover, whatever it was that had caused the lad to start it, by the gargantuan rolls that smashed down ten-ton ingots, it looked as though he were going to finish it. At any rate, he knew what he was up against, and Sam—he watched the grimy figure swing away down the floor in the direction being indicated, and felt the beginnings of a relief which was to find expression in a new title for the boy. Not five minutes later, when he was concluding the errand that had been interrupted by a collision.

"WHAT'S this I hear about the Old Man's kid turnin' cinder-monkey?"

There are very few telephones in a steel mill. But news travels just the same, some of it like lightning, and such was the greeting Slim Jackson had for Sam when he climbed the stairs to the glass-fronted room built above the roll table some fifty feet back of the bloomer. Slim was sitting on a high stool with a man on either side of him, and all three of them were busy at the job of lengthening a snake of steel that crawled back and forth between the huge rolls in front of them. But all three pairs of eyes had flicked around when Sam entered, he had seen them in the light thrown up from the white-hot steel beneath. He suppressed a grin and replied:

"Yeah, he's workin'."

Shortly, pretending great preoccupation, Sam stepped in beside him and began to leaf through the pile of mill orders clapped in a rude desk in front of him. These men were curious, as every man on the mill would be within the next hour or so, and Sam—he continued to search for a certain sheet.

Silence, while the six hands manipulated six levers and the massive machinery responded. Silence, that is, so far as speech was concerned. Otherwise the place resounded with the noises of production. The tumble of the great rolls, the silken swish of the water that bathed them, the clatter and bang as the heavy bloom was shipped over, the hiss and pop of the hot steel as the shining rolls took it between them, the steady pop of relay switches on a far side wall—they blended together in a din that only accustomed ears. (Continued on page 160)

Young Jim

(Continued from page 158)

could understand as those levers were pushed and pulled. And the three men—their eyes were front and their mouths were closed, but their ears were aching for news. Sam knew it.

"This heat—fourteen, twenty-one, ten—handle it with gloves," he ordered. "It's high manganese an' tricky, don't bog it down. Don't give it more'n a half inch at a pass. Twenty-two or so ought to do it."

Slim produced a pencil from his jumper pocket and made some marks on the sheet. He also took his cue. "Tell Slug to hot 'em up good," he said. But he could not resist adding "What's his big idea?"

"What idea?" asked Sam, his eyes inspecting the long bloom as it crawled under their floor for the last time, headed back toward the shears and lighting its way as it went. As though he didn't know what Slim was driving at!

"J. Orcutt—working." In his impatience Slim almost snapped it.

"OH, YOU mean Young Jim. He's got to eat it up. That heat'll be along about noon, watch it," and he was gone.

"Young Jim"—later on Sam demanded the credit for thinking of that name and Sam Jackson confirmed it just then it had slipped out. Maybe he did look like J. Orcutt when he drove from home to job and back again in his yellow roadster; maybe, after that first day, he did resemble the Old Man a son more than a regular employee when he fell in with the dun-colored line of men who made a parade through the timekeepers' gates three times a day; but when he changed to his working clothes and went to work with Pete, he was Young Jim.

For the Old Man's son was sticking—and putting up with the verbal attacks of a carefully warned Slug Williams. That news was all over the plant before the second day was done, from the main office on the hill all the way down through the column of great buildings to the timekeepers' gates. There was nothing to prevent the hearing of tales, and Slug Williams' two helpers became much sought after men. Not that they took part in what followed, for they were too busy. Some one or two of those soaking-pits was always being opened and closed, either for charging or discharging. One by one the stripped ingots had to be put to soak by a crane, and one by one they had to be taken out and sent off to the bloomer, and each time a roof had to be opened and closed again, which was their job. They could observe, however, and listen, because when one of those ceilings had to be roiled back as they had to do was open a valve, a hydraulic ram did the rest. So the mill heard, and as the days went by, wondered.

YES, J. Orcutt was whipping a job. He was slogging away in the dusty heat, poking cinder out, pouring coke breeze in; he was pushing a wheelbarrow in the long tunnel beneath, he was arousing Pete's enthusiasm—a difficult thing to do. It was hard. It blistered hands that weren't used to it—it turned a bright-eyed whimsically talking visitor into a coal-eyed, silent clod at times. Yet he stuck in spite of it, and took insults from Slug Williams.

Verbal woes, beginning on the evening of his very first day, when at quitting time J. Orcutt, black from head to foot, asked where the showers were.

"Showers?" cried Slug, then he laughed. "What for? This ain't Saturday."

"No, but I happen to be a trifle soiled," said J. Orcutt dustily. And

"Do your washin' at home," Slug growled.

"You won't be back tomorrow."

"That," said the other quietly "is where I'm going to fool you." (Continued on page 160)

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Young Jim

(Continued from page 161)

ring was a narrow floor of steel plates, edged by a wall on one side and a long rail that shut off the rams and pistons of the soaking-pot ceilings on the other. The audience was three men—at first, Pete and his two helpers. After that—

Sam Thurber was in the building, talking to Slim Jackson. He could not hear Slug's roar, for the bloomer was at work; but he saw the flood of light that was not shut off and the ingot hanging on the crane's tong. He arrived in no time, the bloomer crew behind him.

Slug landed the first blow, a haymaker that knocked Jim sideways. He staggered and would have fallen had it not been for the long rail. That he grabbed with his right hand, his stagger swinging him around until he struck it with his back. He had time to shake his head just once before Slug was upon him again.

THIS time he met the charge—with a straight-arm jab from his left that caught Slug fair in the mouth and set him on his heels. It was followed with a right that was too high. It struck Slug in the eye. Then Slug came in again, and his greater weight carried him through Jim's fists, his great arms clamped around him.

There they were, locked and straining, when Sam Thurber panted up. He leaped onto Slug's broad back, caving and demanding a halt, but he might have been a grain of dust. Neither of them heard him.

"Let me a bar, I'll crown him," he bawled, but Pete Likanik grabbed his arm.

"Let 'em finish," he rasped, and Sam stood back.

It was plain that Slug was going to fight dirty, not was anyone surprised. He was bent upon setting Jim's back against that rail. He was pushing, slowly, and Jim's feet were scuffing backward, while his hands waved uselessly below Slug's mighty arms. It looked to be defeat. Backward, backward, until the rail touched Jim in the small of his back, then Slug began to bow forward.

"Cut it out, you blackguard!" bawled Sam, and other voices joined him. Carelessly, for Jim had a trick of his own.

Suddenly he braced himself, lifted his feet from the floor and kicked. It knocked Slug's feet out from under him so that Jim's backward fling of his shoulders made them both describe a giant's swing about the bar. Slug struck the floor with a thud, and Jim lit on top of him, to pump up like a cat, prepared for the next move.

"Cut it out, Jim!" Sam yelled. "Get out of there."

IT WASN'T a good place to fight. It was narrower even than the runway, bounded on one side by the withdrawn ceiling of pot twelve and on the other by the long bar that reached from the ram to the closer door of pot thirteen. It was dangerous, too; especially when a brute of Slug's instincts was fighting. There was a chance—but Jim paid to heed. He stood over Slug and panted: "Come on, get up!"

If Slug had been up and Jim on the floor it would have been different every one of the bystanders knew it. Some of them even yelled their advice.

"Jump on him, Jim! Stamp him down!" But he didn't; he waited until Slug rolled over and got to his feet. Then it was a fair fight that no one will forget. Fair because he kept it so. He refused to let Slug come to grips again. And beautiful!

J. O'Connell Durkin, 3rd, he may have been: polo player and automobilist, too; soft-voiced play boy who had no guts, but he had also done something else—an awful lot of buying. For from that time on (Continued on page 163)

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Trapped 330 Feet Underground

(Continued from page 51)

of the miniature railroad. Practically they uncovered him. The man was dead. Then they saw Nick Strake. The miners knew that afterdamp had dropped him. They seized him and fed back to the comparative safety of the stairway, and got to the surface at last.

Such deeds of heroism are almost commonplace when disaster enters a mine. It is such self-forgetfulness and valor that has encouraged the Government to extend its mine rescue work by training the miners themselves in the use of life-saving appliances. About 40,000 are being trained each year. Since the Bureau of Mines was established in 1915, more than a quarter of a million men have received scientific instruction in underground life-saving.

WHAT caused that explosion in the modern, carefully protected mine at Mather? Two survivors offered a plausible explanation. They said they saw a flash of sparks when a cutting machine, used against the face of a drift, severed the insulation on an electric cable. Those bluish sparks ignited a cloud of fine coal particles hovering in the air, a highly explosive combination. As if following a powder train, that explosion swept along the corridor and into side galleries until it struck a tunnel where its leaping flame found rich food and exploded with a force that shook the entire mine.

Probably a similar cause was responsible for the explosion at Bluefields, West Virginia. Coal dust suspended in the air was not suspected as the agency of many mine explosions until comparatively recent times. Miners formerly attributed such explosions to some form of carbon gas. Occasionally a grain elevator blows up as if a ton of dynamite had been detonated within its walls. Experts know now that these explosions are due to the ignition of starch dust. Wherever the dust of combustible materials is present, industry is learning to guard against its hazards. In mines, nowadays, it is customary to fight dust with dust. Pulverized rock is blown onto the walls, roof, and floors of the corridors. This is a preventive against explosions.

MOST Government mine rescue workers are veteran miners, men grown wise to underground dangers. It was their ingenuity which developed the protecting walls—the brattices—which have enabled entrapped men to survive for days after a mine explosion. That was the case with fourteen men who lived as prisoners for twenty-five days far back in a gallery of a French mine at Courrières. An explosion, with its afterdamp, had killed 1,100 men of the 1,795 who worked in the maze of its galleries. Isolated groups fortified themselves against the approach of afterdamp by walling themselves up in remote galleries. They made brattices of mine timbers, coal dust, bits of cloth, their own garments, anything that would make a barrier against the deadly carbon monoxide. Some died from lack of nourishment after waiting days for relief that never came.

"The fact that fourteen men were found and rescued twenty-five days after the explosion and C. P. White an official of the Bureau of Mines, recently, indicated that if communication could have been established not only these but probably many other miners might have been rescued within a few days after the explosion.

One of the problems with which White and his associates are concerned is the development of some unfailing system of communication whereby imprisoned men may exchange signals with men on the surface.

Two methods seem to promise usefulness. One is called the geophone, or earth vibration method. The signals exchanged are taps made with a sledge against

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Trapped 350 Feet Underground

(Continued from page 164)

the rock surfaces. Delicate geophone receivers are employed to catch these signals. Efficient operation requires skill, and the signals would have to penetrate in some instances more than 400 feet of overlying strata.

The other method employs the roof rails of mine workings as electrical conductors. The transmitter is an ordinary microphone, the receiver a watchcase type of telephone. The big advantage of this system is that it permits the use of the voice.

All that Tom Trewartha had as a signaling appliance was a hammer and access to a section of water pipe that was suspended in a clogged shaft of the G. Papet mine at Ironwood, Michigan, during the disaster of 1920 but the rapping signals of his hammer on the pipe were enough to guide rescuers to where he was imprisoned with forty-two others.

HOW swift and effective is modern scientific rescue work was demonstrated last February, when fire broke out in an underground city of Canada. About 130 miles north of Lake Huron is the largest gold mine of North America, the celebrated Hollinger, with a hundred miles of underground passageways and electric railways out into an incredibly rich deposit of gold-bearing ore. It was in this fabulous cave that fire began to rage. Men poured out of the shafts at the surface as fast as cages could be lowered and raised, but a hasty check showed that fifty-one men were trapped in mines of them perhaps miles from the exit shafts. In the tunnels 550 feet below ground the fumes seemed worst. From there dense clouds of smoke surged downward a third of a mile, drawn by the fan currents to the underground workers. The blast spread below ground, mile after mile, the mine timbers roaring into flame under the draft.

Canada has no service to compare with the mine rescue organizations of our state and federal Governments. In this desperate situation officials of the Dominion appealed to Washington. Red tape was slashed. Rescue Car No. 3 was ordered to start from its temporary station on a remote siding in Pennsylvania for the burning gold mine in Ontario.

RECORDS were broken on that swift errand of mercy. Car and crew behind a powerful engine steamed out of Pittsburgh at 9:15 on the morning of February 11; at 9:40 the following morning it arrived at the Hollinger mine. Normally it would require at least forty-eight hours to make that journey.

Those mine-fire fighters from the United States knew there was but one solution to the problem confronting them. The mine atmosphere had to be cleared quickly of the choking smoke. To do this the Americans entered the mine, with their Canadian hosts, all wearing oxygen breathing devices. As they advanced they erected canvas screens. Each screen marked the limit of a rescued area. By forcing air first through one such passage, and then through another, ways were cleared for the advance of other rescuers not equipped with breathing devices. By 11:30 of the morning of their arrival the rescue squads had reached the powder magazine and blocked it off. Two victims of the foul air there were taken to the surface and then further advances were made. By midnight, in places where previously it had been utterly impossible to see objects a foot away, the bodies of victims were being recovered. None, of course, had survived those unlivable conditions.

The Americans pursued their work all day Saturday, through Sunday, Monday, and part of Tuesday, without pausing for sleep, before their work was done. By Monday, so thoroughly had the mine passages been cleared of fumes that oxygen breathing apparatus was worn chiefly as a precautionary measure.

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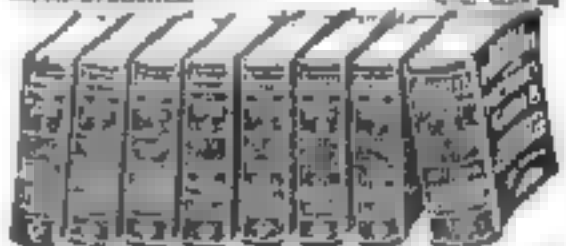
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Camera Reveals Surprising Facts About Great Men

(Continued from page 14)

Once, during the World War, when the King and Queen of the Belgians were visiting the front, an official photographer asked them to pose. His Majesty consented. Then the flustered photographer had to explain that his impromptu studio was in a cowshed! The Queen came to his rescue. "If the light is good there," she said, "nothing else matters." They waded ankle deep through dust and straw. King Albert seated himself. Then the Queen straightened out his hair, and put his trench helmet at just the proper angle. The photograph, against the war-torn background, was an excellent one.

Will Rogers, the cowboy humorist, regards all photographers as his friends until they prove themselves otherwise. Will wants them to give him a little time for preparation, and then he is ready. His "preparation" usually consists of straightening his tie, which has a habit of twisting about on his collar, and of flattening down his hair. Invariably he looks down at the ground.

THE late J. Pierpont Morgan was a renowned enemy of all photographers. It was he who set the fashion of chasing them away with a club. He was sixty before he posed for a photograph. I discovered one reason why, the other day, in the private files of a New York photographer. It was an untouched proof of a photograph of the great financier. It showed that Mr. Morgan had an unsatisfactory bulbous nose, of which he was acutely conscious.

The present J. Pierpont Morgan inherits his father's hatred of the camera. He has, from time to time, employed lucky detectives and guards to protect him from persistent photographers. This may be due to Mr. Morgan's known aversion to publicity, or to a fear of cranks, who might recognize him from published pictures.

John D. Rockefeller eluded the camera for years. On one of the first occasions when he consented to pose, a photographer asked him to remove his hat. He obliged—and the toupee he wore slipped down on one side of his head. The camera man saw it when he printed his plates, and knew it would make the oil king appear slightly rebuked if it should be printed. He destroyed the plates! Nowdays John D. poses willingly enough, invariably wearing a cap or soft hat, but he wants to be shown "in action." When he is on the golf links he will hold a pose swinging a club or making a putt, but he rarely will stand still and face the lens.

JOHN D. ROCKEFELLER, JR., likewise shows no embarrassment in front of the camera, and usually smiles when he is asked to "Hold it please." His wife, however, does not share his nonchalance. One Easter Sunday Mr. Rockefeller, his wife, and little daughter were returning from church when photographers, seeking pictures of the socially elect on Easter parade, approached. Mrs. Rockefeller and his daughter posed. Some time later the multimillionaire old man sought out the photographers and asked them, on behalf of his wife, not to print the photographs. "She was afraid that kidnappers might memorize the child's face, and attempt to steal her."

Even though they have been photographed countless times, some of our famous men will show the public only a favored angle of their faces. President Wilson, for instance, seldom allowed himself to be photographed from the left profile. He had rather a large mole on his left forehead. On the other hand, the late Charles William Eliot, president of Harvard, would permit only his left profile to be shown. A birthmark covered a portion of the right side of his face.

(Continued on page 16)

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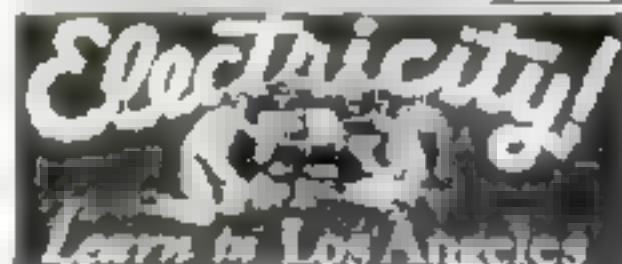
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Are You Fit to Fly?

(Continued from page 15)

18,000 feet without oxygen. The limit at which a flyer can retain consciousness without oxygen is about 25,000 feet, and before reaching this elevation a man's efficiency falls markedly. Altitude acts in a peculiar way. The effects creep on insidiously. The flyer may lose efficiency and even become unconscious without realizing that he is showing any sign of deterioration. It is possible to rate a flyer by a test on the ground, as to his ability to withstand the effects of high altitude.

SPEED in flying is another factor that calls for medical supervision of flyers. When we read of flyers attaining a speed of more than 300 miles per hour, we wonder where the end will be. The limit to flying in a straight line is a question, but when turns are made at high speed the flyer frequently has a moment of unconsciousness—when everything turns black. This is a matter of centrifugal action. As the plane turns at right angles to its former course it is banked, and the flyer's body is then at right angles to its former position. This results in draining the blood from the head, causing a temporary faint.

A French physician named Garneau performed some experiments with dogs in which he rotated them rapidly on a wheel. Some of the dogs were killed by the rapid turns. Autopsy showed actual brain damage as the cause of death. Recently, a flyer in diving a ship at terrific speed and then suddenly coming upwards, not only complained of faintness at the time, but for days afterwards was dull and his eyes showed congestion of the retina. This was probably a case of slight damage to the brain. There is a limit, then, to speed beyond which a man may not go and live.

IN CONCLUSION, then, do not plan on flying until you have been examined physically. After you enter the game keep yourself physically fit and look on the physical tests required as weather vane of your continued fitness to fly. If you plan on altitude or speed flying consult a flight surgeon before you do it.

Odd Equipment of Byrd's Men

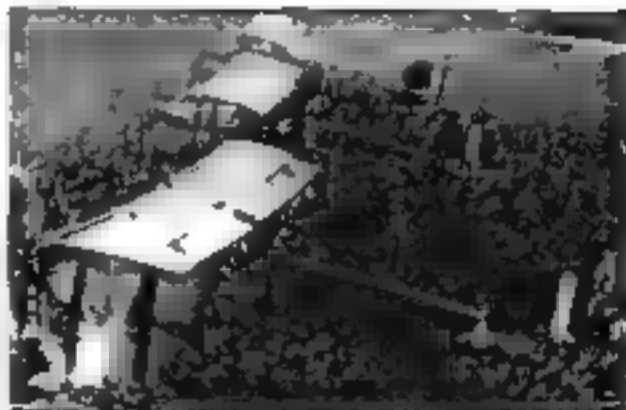
(Continued from page 57)

It would take a day, a night, and part of another day to exhibit the film.

Scientific instruments in bewildering array verify Commander Byrd's statement that this is to be an organized attempt to study Polar regions, rather than a spectacular dash of on lasting value. The \$40,000 worth of technical equipment includes electrometers and magnetographs to record photographically all variations in the earth's electric and magnetic fields. Besides these instruments, a photomicroscope will picture minute living organisms in Antarctic waters, and a new sounding device will chart the little-known bottom of the Antarctic Ocean, trace the coast line of the Antarctic continent, and find if it could ever have been joined with South America as a passageway between the Old and New Worlds.

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A Prophet of Science Looks into the Future

(Continued from page 170)

than can be recovered in more useful work."

In the whole subject of matter, in fact, Dr. Tesla holds views that are startlingly original. He disagrees with the accepted atomic theory of matter, and does not believe in the existence of an "electron" as pictured by science—or, he maintains, if it can exist at all, it does so only in perfect vacuum.

"To account for its apparently small mass, science conceives the electron as a hollow sphere, a sort of bubble," Tesla says. "Now, a bubble can exist in such a medium as a gas or liquid because its internal pressure is not altered by deformation. But if, as supposed, the internal pressure of an electron is due to the repulsion of electric masses, the slightest conceivable deformation must result in the destruction of the bubble!"

"Just to mention another improbability, the force tending to tear an electron apart is, in pounds per square inch, represented by the staggering figure of \$56,898 followed by twenty-one zeros—and this is \$15,798,000,000,000,000 times greater than the tension that tungsten wire can withstand! And yet it does not burst! Not even when it is hurled against an obstacle with a speed hundreds of thousands times greater than that of a bullet!"

AND—more widely interesting in this day of radio—this strange, many-sided man clings to the opinion he expressed in his scientific investigations published from 1888-1889, that the source of all rays we know is always a stream of tangible particles or "corpuscles," rather than waves or vibrations. Even before the discovery of radium, Tesla expressed his belief that radioactive rays were of this sort, a view ridiculed at that time. When radium was discovered it was found actually to emit particles of matter—flying nuclei of helium atoms, called "alpha" rays. Tesla has maintained ever since that radium is not a generator but a transformer of energy, the emanations being caused by cosmic rays of immense power capable of penetrating all obstacles however thick. The existence of this radiation—which, he says, should not be confounded with the comparatively very feeble "cosmic rays" observed more recently—he has proved by mathematical theory agreeing closely with experiment.

These conclusions Tesla has drawn from experiments with a remarkable vacuum tube of his own invention, with a single electrode, operated at millions of volts.

I asked Tesla what part of his life work lay closest to his heart. And the answer surprised me. It was not the world wireless system, nor the airplane. It was not the induction motor, today the basis of industries in which billions of dollars are invested all over the world. Instead, it was the discovery of the principle that preceded the induction motor—the "rotating magnetic field."

"When I made the discovery of the rotating magnetic field," Dr. Tesla said, "I was a very young man. The revelation came after years of concentrated thought and it was my first great thrill."

"It was not only a valuable discovery, capable of extensive practical applications. It was a revelation of new forces and new phenomena unknown to science before."

"No," Dr. Tesla said with some feeling. "I would not give my rotating field discovery for a thousand inventions, however valuable, designed merely as mechanical contraptions to deceive the eye and the ear. A thousand years hence, the telephone and the motion picture camera may be obsolete, but the principle of the rotating magnetic field will remain a vital, living thing for all time to come."



Offices are also maintained at Los Angeles, Calif., for Western states. European headquarters have recently been established at London, England.

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AN AMERICAN scientist has made a discovery that touches the very keynote of health, vigor, and welfare of men past 40. He has found a simple home treatment for prostate gland trouble.

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Without medicine, surgery, violet rays or trick treatment, he has found a way to directly stimulate the prostate gland—often driving out the congestion and making it function its normal way. So great has been the success of this treatment that an organization has been established to furnish it to the millions of men who are in need of it.

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chronic fatigue, depression and weakness are symptoms.

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This institution has published a little book, "Why Many Men Are Old at 40" which reveals amazing facts about old age. If you suffer with prostate trouble, it may be a godsend to you. While the edition lasts it will be mailed Free. Don't go on with conditions that may lead to surgery—or that takes the pep, energy and joy of living out of life. Mail the coupon below immediately to THE ELECTRO THERMAL CO.

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John Kenlon—Fire Fighter

(Continued from page 173)

in the cellar of a five-story building at the corner of Grand Street and Broadway. Stocks of rubber goods and heavy textiles gave off impenetrable clouds of smoke; the night was hot and damp, the smoke refused to rise, and dozens of firemen were laid low before Kenlon arrived. He penetrated to the center of the building and found that a large circular stairway ran directly up to the roof, where it was surmounted by a glass skylight. Kenlon ordered this skylight to be broken, with the result that a rapid ventilating draft was created to carry off the smoke. He then stationed his men on the roof and had them pour ten thousand gallons of water a minute into the heart of the flame. It is significant that while fifty firemen were knocked out by smoke before Kenlon arrived, not one was overcome after he took charge.

This and a thousand similar incidents have persuaded most firemen that John Kenlon brings a rare and flexible quality of genius to his task of mastering fires. Believing as he does that every fire problem has an accurate solution, he has made it his business to discover that solution in the quickest possible time, and with the least danger to his men.

The question is often asked, "Why has New York had no great conflagration?" With dangerous fire hazards on all sides, with a teeming population, and with high prevailing winds, it seems almost miraculous that the city has not been scourged by a great conflagration. Ask John Kenlon for an answer to the question and he will say quite humbly:

"We have all been very lucky here in New York."

But who can say what portion of that "luck" has been Kenlon's effort to establish fire-fighting on a scientific basis, and his personal success in keeping it there?

Next month: How John Kenlon's application of scientific principles to his job has revolutionized the whole profession of fire engineering.

New Events in Astronomy

(Continued from page 66)

shaped border of the sun visible. Unfortunately, the eclipse lasts too short a time for valuable observation in the most favored place it was visible total but a second and a half.

If a Comet Should Hit Us

WOULD a head-on collision of the earth with a comet—a perfectly possible, though unlikely, occurrence—spell the world's doom?

"It might be disastrous—or it might be more spectacular than dangerous," says P. Davidovitch, of Harvard Observatory. As far as we know, comets are simply loosely-knit swarms of flying meteorites, whose direct impact might not even jar the earth. Probably a comet merely grazing us would be torn apart by the drag of the earth's gravity and fall as a shower of meteorites. This is thought to have been observed on more than one occasion.

Nor would there likely be danger if the tail of a comet—known to contain such poisonous gases as carbon monoxide and the more deadly cyanogen—should sidewipe our world, so thin are its gases. In 1801 the earth actually passed through the tail of a great comet, but the few who knew it saw only a slight dimming of the sun and a curious yellowish-tinted sky.

Not since 1910, when saw two great comets, has a really brilliant one crossed the sky.

Where do they come from? Today it is believed that they are stray wanderers within our own solar system, members of it as much as the planets and moons. Fortunately they are not weighty enough to interfere with the motion of the planets, the largest of them all, a giant of 1845 with a tail 150,000,000 miles long, passed close to us without producing the slightest effect upon the earth's orbit.

This One



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Lots of people know how to make a dry cell— but not the Eveready Columbia

PROBABLY you know how to make a dry cell. No secret about it. The principal ingredients are zinc, sal ammoniac, manganese, carbon. With just those four things you could make a dry cell that would work—for a time. But we add tiny quantities of other things, too, measure them with great exactness, add them just so, control every process by laboratory tests, and turn out a product that is scientifically exact. Some of the ingredients we mine in our own mines, refine in our own mills, and thus govern quality completely. There's no secret about the Eveready Columbia except this: We know how to make it. Thirty-three years of scientific investigation and controlled manufacture have developed it until today it is the greatest dry cell made. Available in single cells, and in batteries of 4, 5 and 6 cells, 6, $7\frac{1}{2}$ and 9 volts, ready-connected in a waterproof steel case and sold as the Eveready Columbia Hot Shot.

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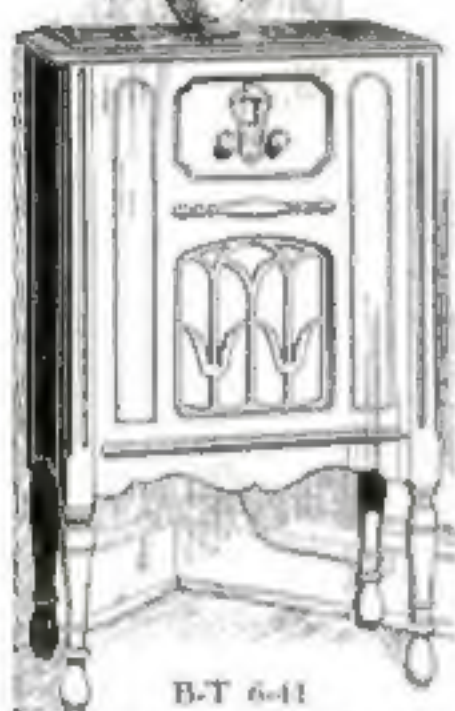
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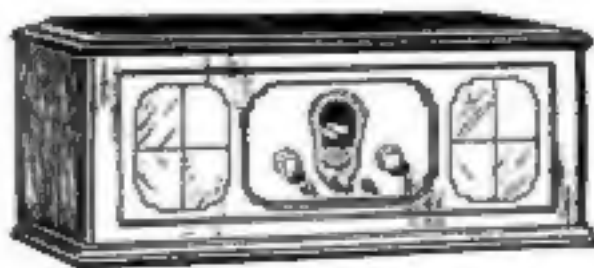
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Mild and soothing even to tender tissues, full-strength Listerine has deadly power against germs. Repeated tests, separately conducted in three noted Bacteriological Laboratories, have agreed in proving that Listerine kills *Micrococcus Aureus* (the pus germ) and *Bacillus Typhosus* (the typhoid germ), in less than 15 seconds! In all tests, the average number of bacteria was more than 200,000,000 per cubic centimeter (a cube less than four-tenths of one inch on each side).

This germicidal power of Listerine,

demonstrated on the standard bacteria used by the U. S. Government in testing antiseptics, explains its 47-year proved effectiveness as a gargle for sore throat, and as a safeguard against infection.

This winter learn how Listerine can help you. Gargle with this pleasant antiseptic morning and night, and repeatedly after exposure to bad weather or large groups of people. And before every meal, before touching the face at any time, rinse the hands in full-strength Listerine.

We believe that you will be pleasantly surprised by a winter in which colds trouble you much less than previously.

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your nose and throat passages from your hands which

TO AVOID COLDS



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